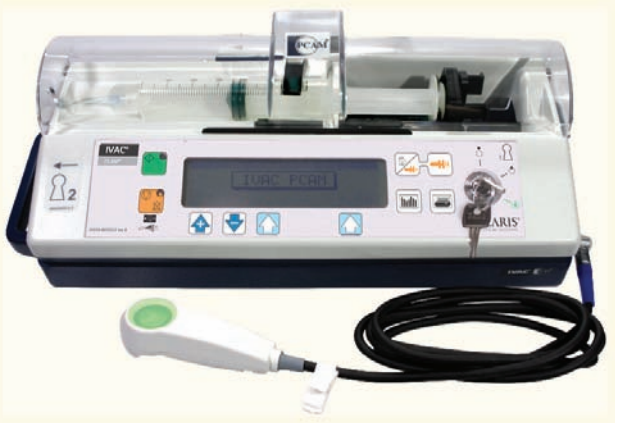
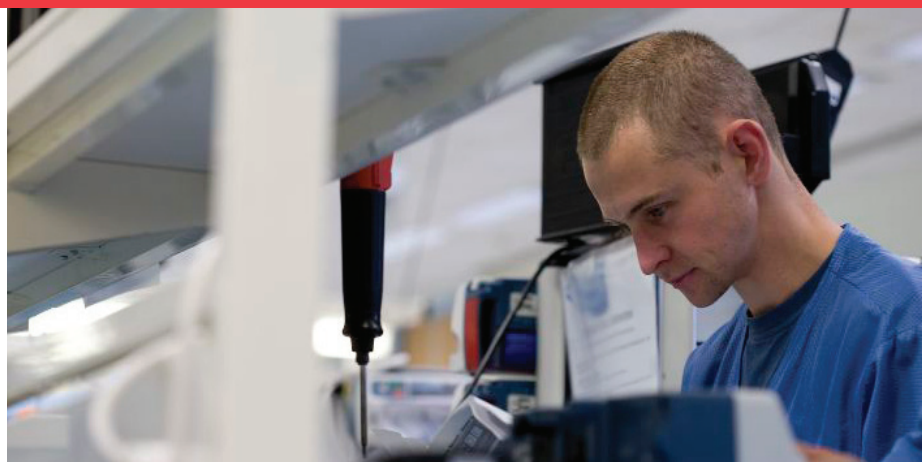
IVAC® **PCAM**® Syringe Pump

Technical Service Manual





CardinalHealth

This manual has been prepared for use by qualified service personnel only.
Cardinal Health cannot accept any liability for any breakdown or deterioration in performance of parts or equipment resulting from unauthorised repair or modification.

Cardinal Health, 1180 Rolle, Switzerland

CE
0086

Alaris®, IVAC® and PCAM® are registered trademarks of Cardinal Health, Inc. or one of its subsidiaries.
All other trademarks belong to their respective owners.

© 2005-2006 Cardinal Health, Inc or one of its subsidiaries. All rights reserved.

Contents

Chapter 1

Introduction & Start Up

In this chapter

Introduction

The IVAC® PCAM® Syringe Pump is designed to provide a small, self-administered dose of analgesic, as and when the patient demands it by activating a hand operated button. The clinician can select limits for various parameters, including the size of each individual dose, the minimum time between doses and the number of doses allowed during a period. In parallel to the patient controlled operation the pump allows the clinician to set an automatic loading dose which will be delivered at the onset of treatment. Similarly a continuous background infusion which is delivered irrespective of the patients demands for analgesia, can also be selected.

In addition, the pump will automatically record valuable information about each patients treatment and their individual demands for analgesia. This allows further analysis of the frequency with which analgesia is being requested, the total dose delivered etc.

Product Familiarity

Prior to operation of the pump and prior to attempting any repairs or servicing, carefully read the *Directions for Use* (*DFU*)

As part of continuous improvement, product enhancements and changes are introduced from time to time.

Purpose of this Manual

This Technical Service Manual describes how to set up, test and maintain the IVAC® PCAM® Syringe Pump. This manual is intended for use by personnel experienced in medical equipment testing and maintenance procedures.

Conventions Used in this Manual

BOLD	**Used for pump Display names, access codes, controls and indicators referenced in this manual, for example, GENERAL OPTIONS menu, access code 251, LOCK 1 keyswitch.**
'Single quotes'	**Used to indicate cross-references made to another section of this manual. For example, see Chapter 2, 'Configuration & Calibration'.**
underline	**Used to indicate links to another section of this manual.**
Italics	**Used to refer to other documents or manuals. For example, refer to the relevant** *Directions for Use (DFU)* **for further information. Also used for emphasis, for example, ...position the** *narrow* **end of the tool...**
	**Wherever this symbol is shown a Hints & Tips note is found. These notes provide useful advice or information that may help to perform the task more effectively.**
	**Wherever this symbol is shown a Toolbox note is found. These notes highlight an aspect of test or maintenance that is important to know about. A typical example is drawing attention to a software upgrade that should be checked that it has been installed.**

General Precautions

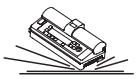
Prior to using this pump, carefully read the Operating Precautions described in the *Directions for Use (DFU)***.**

This pump contains static-sensitive components. Observe strict precautions for the protection of static sensitive components when attempting to repair and service the pump.

An explosion hazard exists if the pump is used in the presence of flammable anaesthetics. Exercise care to locate the pump away from any such hazardous sources.

Dangerous Voltage. An electrical shock hazard exists if the casing of the pump is opened or removed. Refer all servicing to qualified service personnel.

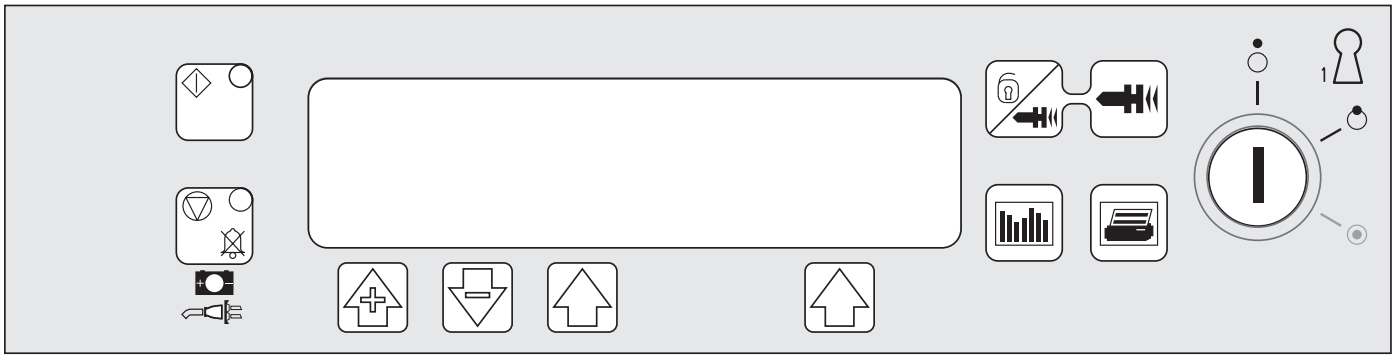
This pump is protected against the effects of high energy radio frequency emissions and is designed to be fail safe if extremely high levels of interference are encountered. Should false alarm conditions be encountered, either remove the source of the interference or regulate the infuse by another appropriate means.



If the pump is dropped, subjected to excessive moisture, humidity or high temperature, or otherwise suspected to have been damaged, remove it from service for inspection by qualified service personnel.

Front Panel, Controls and Indicators

Front Panel



Controls and Indicators

START — **Press to start the infusion. The green LED will flash during infusion.**

STOP — **Press to stop/hold the infusion. The amber LED will be lit while on hold.**

BATTERY — **When illuminated, indicates that the pump is running on the internal backup battery. When flashing, indicates that the battery power is low, with less than 30 minutes of use remaining.**

AC POWER — **When illuminated, indicates that the pump is connected to an AC power supply and the battery is being charged.**

PLUS/MINUS BUTTONS — **Use to move cursor and to increase or decrease values shown on main display.**

ARROW BUTTONS — **Use as softkeys in conjunction with the prompts shown on the display. For example, to select the CALIBRATE option.**

PURGE/ BOLUS — **Press and hold both buttons to purge the extension set during set up. See 'Basic Features' for further information.**

HISTORY — **Press to display PCA demands and drug infused history graphs, 24 hour review and event log.**

PRINT — **Press to print patient history. Note: A suitable printer must be connected to the pump.**

LOCK 1 — **Insert key into LOCK 1 keyswitch and turn key to switch between OFF, SET and RUN positions.**

OFF

OFF - Turns the power off.

SET

SET - Use to select or modify protocols and to access configuration and test routines.

RUN - Use to start the infusion.

RUN

Note: Switching from RUN mode to SET mode without first pressing the STOP button automatically stops the infusion.

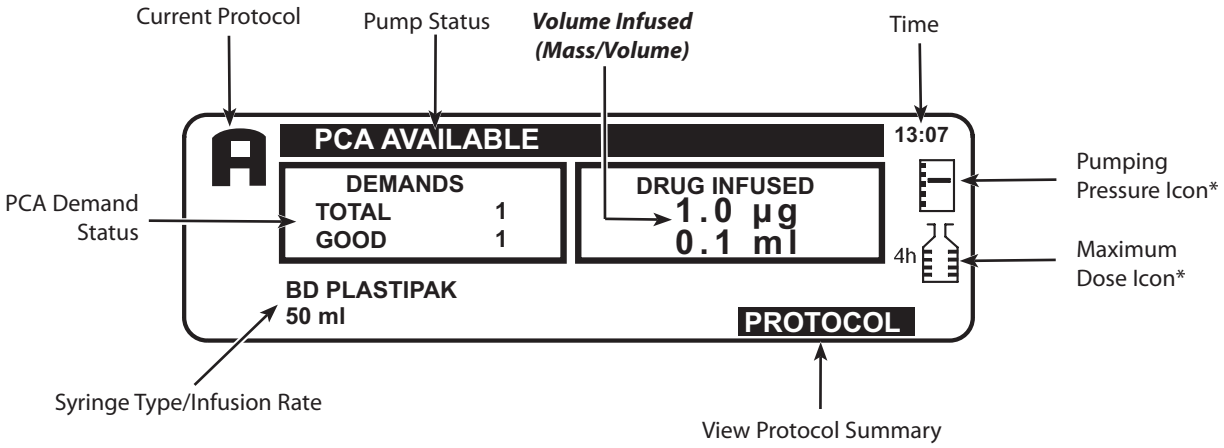
LOCK 2 — **Insert key into LOCK 2 and turn key clockwise to open the syringe cover.**

This key lock is located on the left side of the pump

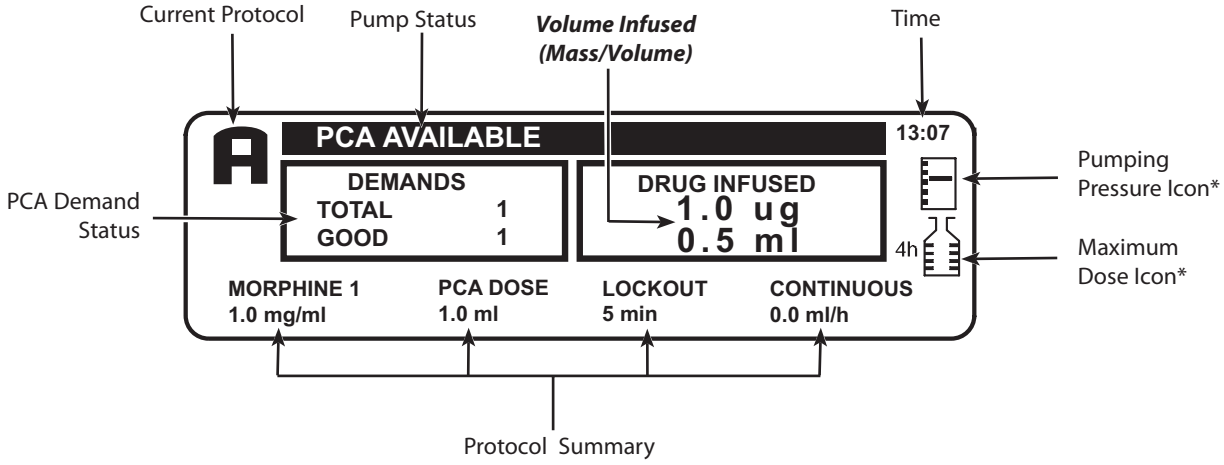
Main Display

Main Display

Example Software V3R2

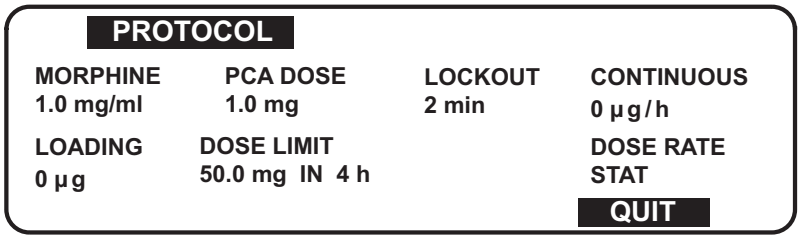


Example Software V2R8



Protocol Summary Screen

Example: Software V3R2 only



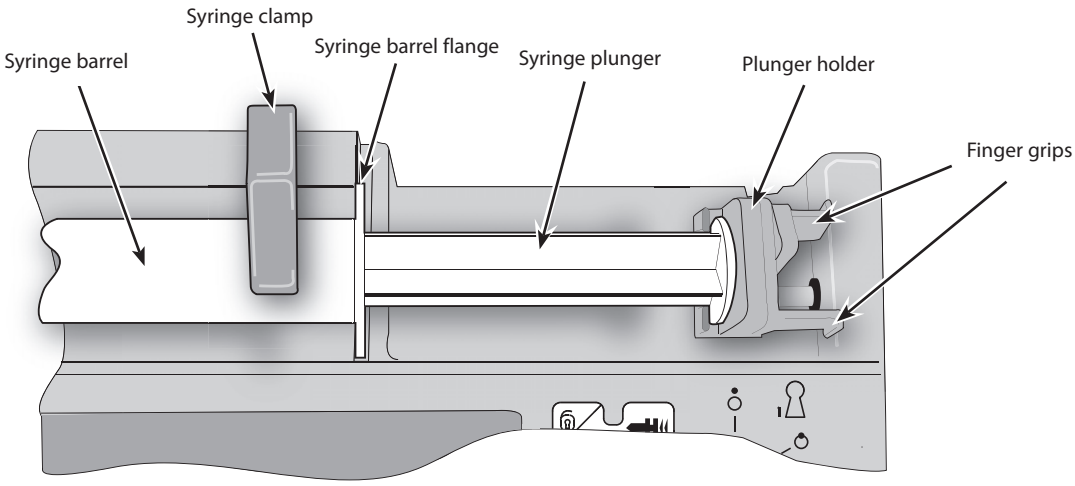
* These icons are not displayed when disabled.

Loading a Syringe

1. Open the cover by turning the key in **LOCK 2**.
2. Squeeze the finger grips together on the plunger holder and slide the mechanism to the left.
3. Lift the syringe clamp and rotate to the left.
4. Insert the syringe into the slots on the plunger holder (see Figure 1).
5. Squeeze the finger grips on the plunger holder and slide the mechanism to the right until the syringe barrel flange locates into the V slot (see Figure 2).

Ensure that the syringe is advanced until the syringe barrel flange touches the front of the V slot closest to the syringe clamp. This is important to prevent delay at the start of the infusion.

6. Release the finger grips. Apply gentle pressure on the plunger holder to ensure that the drive is engaged.
7. Rotate the syringe clamp until it locks onto the syringe barrel (see Figure 2).
8. Check that the syringe plunger and syringe barrel flange are correctly located into their slots.



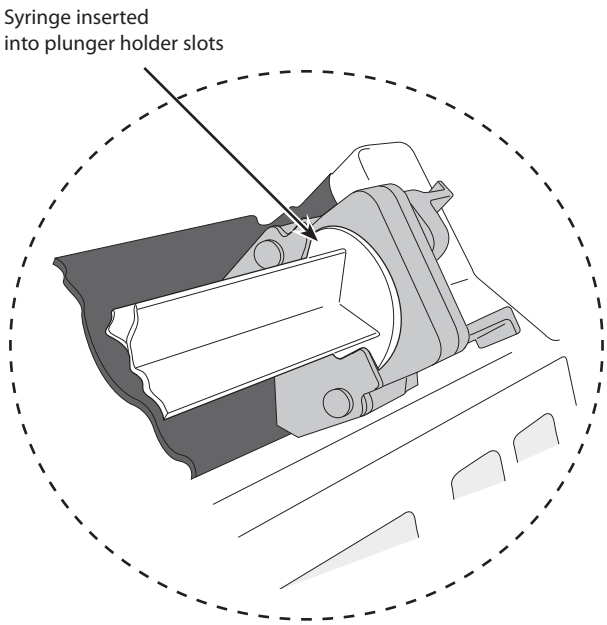


Figure 1.

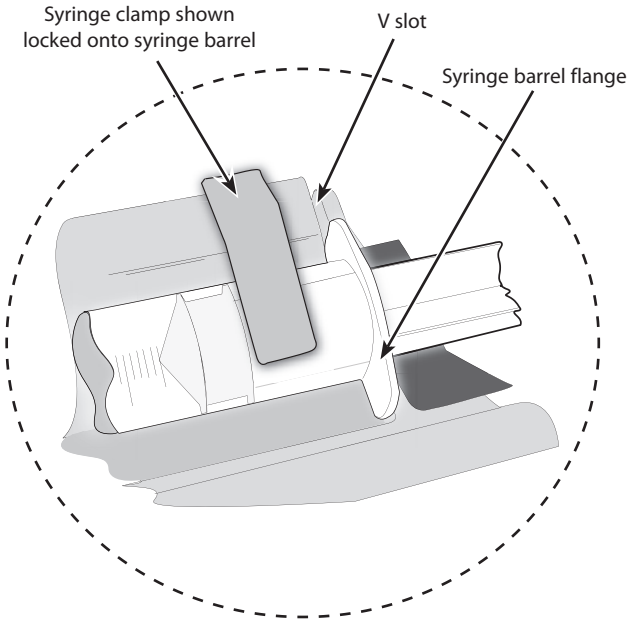


Figure 2.

Starting the Pump

1. Connect the pump to AC Mains.
2. Open the cover by turning the key in **LOCK 2**.
3. Load the syringe. See instructions in previous section.
4. Power the pump ON by switching **LOCK 1** to the **SET** position.
5. **NEW PATIENT? NO** retains patient data then displays the last protocol used. **YES** clears previous patient data then displays preset protocol A.
6. Check the protocol displayed. If required, select the **NEXT PROTOCOL** option to choose an alternative preset protocol, or select the **MODIFY PROTOCOL** option to adjust the current protocol. See 'Modifying a Preset Protocol' below for further information.
7. Switch **LOCK 1** to the **RUN** position and remove the key.
8. **CONFIRM PROTOCOL**. Select **OK**.
9. **CONFIRM SYRINGE**. Select **OK**.
10. Purge (cover must be open): Press and hold the  buttons together.
11. Close the cover.
12. Connect the pump to test equipment as required (see Chapter 2, 'Configuration & Calibration' and Chapter 3, 'Routine Maintenance').
13. Press the  button to start operation.

Modifying a Preset Protocol

1. Switch **LOCK 1** to the **SET** position. **PROTOCOL SUMMARY** is displayed.
2. Select the **MODIFY PROTOCOL** option (this option is not available when disabled). The current protocol parameters/values are listed.
3. Use the  buttons to move up/down the list of parameters. To change a parameter, highlight it and select **ALTER**. Use the   buttons to toggle the values then select **OK** to confirm and return to the **PROTOCOL SUMMARY**. Note: A modified protocol has no preset letter in the top left corner of the **PROTOCOL SUMMARY**.

Note: See 'Preset Protocol Setup' in Chapter 2 for details of protocol parameters.

If enabled, an additional 'generic' drug with parameter limits set to maximum values can be selected when modifying protocols. Indicated by the drug name ←—XXX DRUG—→, the drug can be selected from the preset list of drug names.

Basic Features

Purge

Press and hold the buttons together to deliver a limited volume of fluid in order to purge the extension line prior to being conected to the patient.

- **The purge feature cannot be activated when the cover is closed**
- **Ensure the extension line is disconnected from the patient before purging the line**
- **Alarms are not disabled during a purge operation**

Clinician Over-ride

Press and hold the button for 2 seconds then enter the pre-programmed clinician over-ride code to use this feature. Clinician over-ride can be used in **RUN** mode to administer an additional bolus dose or a continuous background infusion of a limited dose and duration, for example, during the PCA lock out period. It can also be used in **SET** mode to allow modification of the pre-set PCA Protocol when this option has been disabled.

For further information, see 'Access Codes' in Chapter 2.

- **If the over-ride code is incorrectly entered more than three times, the event CLIN. ACCESS TAMPER is logged in the event log and a warning appears on the Display**
- **Delivery of the clinician over-ride continuous infusion will automatically halt while a Patient or Clinician over-ride bolus is being administered**
- **To cancel clinician over-ride during delivery, press the STOP button then select YES**

History

Pressing the button provides records of patient history and events since NEW PATIENT was last selected:

- **Press x 1 to display an hour-by-hour record of the number of good/failed PCA demands and the total drug infused over the last 24 hours**
- **Press x 2 to display a graph of the good/failed PCA demands over the last 24 hours**
- **Press x 3 times to view a graph of the total drug infused over the last 24 hours**
- **Press x 4 times to view the event log**

Print

With a suitable printer connected (see 'Printer Set Up' on the following page), pressing the button provides printouts of Patient History, Protocol Summary and the Event Log. Refer to the *DFU* **for detailed printing instructions.**

Notes:

1) Access to the full Event Log can be enabled by entering access code 794.

2) Continuous printing can be configured, see 'General Options (251)'.

Pressure

When enabled, this icon is shown on the Display. It provides a visual indicator of current pumping pressure and pressure level at which the alarm will operate.

Maximum Dose

When enabled, this icon is shown on the Display. It provides a visual indication of the amount of drug administered during the limit period (as shown to the left of the icon). If the dose limit reaches the alarm level, the bottle icon will appear full, the pump will stop infusing and the message Max Dose Limit is displayed. The icon will flash until the dosing is less than the maximum dose limit. Clinician over-ride is always available.

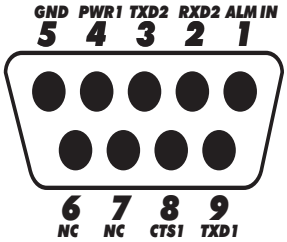
Printer Set Up

To set up a printer, fit a suitable printer with a serial interface cable and connect to the pump. See list of recommended printers below. See also PRINT button functions on previous page.

Cable Requirements

RS232 9-pin D type (1000SP01008)

Wiring connections



Pump		Printer	
Female		Male	
Pin 5	GND	Pin 5	GND
Pin 8	CTS1	Pin 8	CTS1
Pin 9	TXD1	Pin 3	RXD1

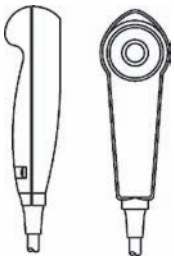
Recommended printers

- Seiko DPU-414, thermal printer (use cable 1000SP01184)
- Citizen N60 (use cable 5000SP00010)
- Canon Bubblejet (use cable 5000SP00008). Note: A serial to parallel adapter is required.

Continuous Printing

To configure continuous printing of events as they occur, enable the **CONTINUOUS PRINT** option in **GENERAL OPTIONS**.

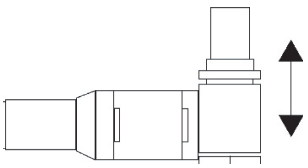
Patient Hand Set



The electronic patient hand set is designed to be ambidextrous and suitable for both adult and paediatric use.

The indicator light can be configured to show when the PCA dose is available or being delivered. Should the clinical situation require it, the indicator light can be disabled. The PCA button will provide feed-back on all, or just good demands. See Chapter 2, 'General Options' for **HANDSET MODE** configuration details.

The patient handset does not contain any latex.



The hand set connector is a latching (but non-locking) connector. To remove, hold the body of the connector and pull away from the pump. If required, the pump can be operated in continuous or clinician over-ride modes without the hand set connected.

Note: An alarm warning will operate if the hand set is disconnected from the pump while it is in operation, or when the handset is connected to the pump with the PCA button depressed.

Chapter 2

Configuration & Calibration

In this chapter

Access Codes

The syringe pump software contains a number of configuration and test routines that can be accessed using a technical access code as shown in the table below.

Code	Title	Description
111*	HOSPITAL NAME	Configure name of hospital/ward to be displayed when pump is powered on and when pump is in 'sleep' mode (when DISPLAY SLEEP is enabled). To set the hospital name, use the buttons to toggle through characters and the button to adjust, then select OK to store.
123	SELF TEST	Self test routine begins from the start. See Chapter 3, 'Routine Maintenance' for further information.
124	SELF TEST	Self test routine begins at internal PSU voltage test.
125	SELF TEST	Self test routine begins at display test.
126	SELF TEST	Self test routine begins at declutch test.
127	SELF TEST	Self test routine begins at handset test.
167	COMMS LEARN MODE	Configuration set via comms interface.
168	COMMS TEACH MODE	Configuration output to another device (pump).
243	SYRINGE SIZE CALIBRATION	Syringe size measurement calibration. See 'Calibration Procedures' on the following pages for instructions.
251	CONFIGURATION OPTIONS MENU	Configuration of drug limits, options, protocols and real-time clock. See 'Configuration Options (251)' on the following pages for further details.
359	BUILD CONFIGURATION	Configure language and syringe range.
376	SERVICE LOG	Review and clear service log errors, hours of battery use and hours of pump on time. To reset the service log to zero press the RESET softkey.
501**	MASS DOSING	Enable mass dosing. Drugs and protocols use mass dose mode.
502**	VOLUME DOSING	Enable volume dosing. Drugs and protocols use a mix of mass and volume.
611	TOTAL MEMORY CLEAR	Reset memory. Note that the pump will require full calibration.
717	OCCLUSION CALIBRATION	Occlusion calibration. See 'Calibration Procedures' on the following pages for instructions.
794	FULL EVENT LOG	Enable access to full Event Log.
835	MODIFY CLINICIAN CODE	Change the 3-digit clinician over-ride code.

* This option is not available on pumps with software version V2R8 and below.

** These options are no longer in use on pumps with software version V3R2 and above. See **DOSE MODE** in 'Drugs and Safety Limits' and **MIX MASS & VOL MODES** in 'General Options (251)'.

Entering an Access Code

Each menu (and certain individual options) has its own three-digit technical access code which is entered using the following procedure:

1. Hold down the button and switch **LOCK 1** to the **SET** position.
2. When the display shows **ACCESS CODE 0 0 0**, release the button.
3. Enter the required access code "XXX" using the buttons in conjunction with the button (to select the **NEXT** option to move through the digits).
4. When the required code is shown, select the **ENTER** option to confirm.

Configuration Options (251)

Enter the access code **251** (see 'Entering an Access Code' on the previous page for instructions). The **CONFIGURATION OPTIONS** menu is displayed:

CONFIGURATION OPTIONS MENU	
Option	**Description**
DRUG NAMES AND SAFETY LIMITS	**Set drug names and limits. See the next section for further details.**
GENERAL OPTIONS	See 'General Options (251)' for further details.
PROTOCOL DEFAULT SET-UP	**Set default protocol and alter preset protocols. See 'Preset Protocol Set Up' for further details.**
CLOCK SET	**Set the internal clock.** **To set the clock, use the buttons and the button to adjust, then select OK to store.**  **The internal clock is the reference against which patient history and events are stored. Patient history should always be recorded and if required, printed prior to changing the clock.** **Changing the clock will automatically:** **• Reset the time and date against which all new patient history is stored and may affect the presentation of the history graphs.** **• Clear previous patient data. Only NEW PATIENT? YES will be available at start up.**

Drug Names and Safety Limits Set Up (251)

1. Enter the access code **251** to display the **CONFIGURATION OPTIONS** menu.
2. Select **DRUG NAMES AND SAFETY LIMITS** using the buttons then select **ENTER**. **DRUG 1** is displayed.
3. Select **NEXT DRUG** to choose another drug or select **MODIFY DRUG** to modify the current drug, as detailed below. Alternatively, select **QUIT** to return to the **CONFIGURATION OPTIONS** menu.
4. Step through each **DRUG** option (see table below) and modify as required.
   - Use the buttons to toggle/select a value then select **OK** to confirm and continue to the next option.
   - Use the button at any time to go back to the previous option.
5. When set up is complete, switch **LOCK 1** to the **OFF** position.

DRUG NAMES AND SAFETY LIMITS	
DRUG option	**Description**
DRUG NAME	**Enter drug name.** **Use the buttons in conjunction with the button (to go to the next drug name letter).**
DOSE MODE*	**Select the dose mode:** **VOLUME** **Volume mode. Drugs and protocols use volume based units. Not available when MIX MASS & VOL MODES is disabled.** **MASS** **Mass mode. Drugs and protocols use mass based units only.**
MINIMUM: DRUG CONC.	**Set the minimum drug concentration between 1 µg/ml and 999 µg/ml or 1.0 mg/ml and 99.9 mg/ml. OFF is also available in Volume mode.**
MAXIMUM: DRUG CONC.	**Set the maximum drug concentration between 1 µg/ml and 999 µg/ml or 1.0 mg/ml and 99.9 mg/ml. Maximum value cannot be set below the minimum value.**
MINIMUM: LOCKOUT PERIOD	**Set the minimum lockout period (0 - 180 minutes).**
MAXIMUM: LOCKOUT PERIOD	Set the maximum lockout period **(0 - 180 minutes).** Maximum period cannot be set below minimum period.
MINIMUM: PCA DOSE	**Set the minimum PCA dose. In Mass mode - between 0 µg and 999 µg or 1.0 mg and 99.9 mg. In Volume mode, between 0.0 ml and 99.9 ml.**
MAXIMUM: PCA DOSE	**Set the maximum PCA dose. In Mass mode between 0 µg and 999 µg or 1.0 mg and 99.9 mg. Volume mode between 0.0 ml and 99.9 ml.**
MAXIMUM: CONTINUOUS	**Set the maximum continuous dose. In Mass mode - between 0 µg/h and 999 µg/h or 1.0 mg/h and 99.9 mg/h. In Volume mode - between 0.1 ml/h and 25.0 ml/h (V2R8 or below), between 0.1 ml/h and 35.0 ml/h (V3R2 or above and for syringes >50ml).**
MAXIMUM: LOADING DOSE	**Set the maximum loading dose. In Mass mode - between 0 µg and 999 µg or 1.0 mg and 99.9 mg. In Volume mode - between 0.0 ml and 99.9 ml.**
MAXIMUM: MAX LIMIT	**Set the maximum limit. In Mass mode - between 0 µg and 999 µg or 1.0 mg and 999 mg. In Volume mode - between 0.0 ml and 999 ml.**
MAXIMUM: CLINICIAN BOLUS	**Set the maximum clinician bolus dose. In Mass mode - between 1 µg and 999 µg or 1.0 mg and 99.9 mg. In Volume mode - between 0.1 ml and 99.9 ml.**

***** This option is not available on pumps with software version V2R8 and below.

Note: For pumps with software version V2R8 or earlier, the options may vary, or will not be available. Refer to the relevant *DFU* for comprehensive information.

General Options (251)

1. Enter the access code **251** to display the **CONFIGURATION OPTIONS** menu.
2. Select **GENERAL OPTIONS** using the buttons then select **ENTER**.
3. Use the buttons to toggle/alter a value then select **NEXT** to move to the next option. Select **QUIT** at any time to go back to **GENERAL OPTIONS** menu.
4. When set up is complete, switch **LOCK 1** to the **OFF** position.

<table>
<tr><th colspan="6">GENERAL OPTIONS
Software version: V3R2</th></tr>
<tr><th></th><th>Option</th><th colspan="4">Description</th></tr>
<tr><td>1.</td><td>ICONS ON DISPLAY</td><td colspan="4">YES: The  (Pressure) and  (Max dose) icons are shown on the Display.
NO: No icons are shown on the Display.</td></tr>
<tr><td>2.</td><td>PROTOCOLS IN USE</td><td colspan="4">Set the number of preset protocols to be available (1 to 10).</td></tr>
<tr><td>3.</td><td>MODIFY PROTOCOL</td><td colspan="4">YES: Allows protocols to be modified in SET mode.
NO: MODIFY PROTOCOL option disabled (removed from SET mode).</td></tr>
<tr><td>4.</td><td>HANDSET MODE</td><td>MODE
BEEP
Handset light:
PCA STOPPED
PCA AVAILABLE
PCA DELIVERING
PCA LOCKOUT</td><td>A
GOOD

OFF
ON
FLASH
OFF</td><td>B
ALL

ON
ON
ON
ON</td><td>C
ALL

OFF
ON
FLASH
ON</td></tr>
<tr><td>5.</td><td>DELAYED CALL BACK</td><td colspan="4">YES: Call-back alarm can be delayed (10 - 90 minutes).
NO: Call-back will be cancelled (up to 2 minutes, or extended to 15 minutes).</td></tr>
<tr><td>6.</td><td>DISPLAY SLEEP</td><td colspan="4">YES: During operation, Display goes blank (into sleep mode) after 2 minutes.
NO: Display stays on during operation.</td></tr>
<tr><td>7.</td><td>CHIRP LOW ALARMS</td><td colspan="4">YES: "Chirp" alarm occurs during use of battery/near end of battery.
NO: No "chirp" alarm during use of battery/near end of battery.</td></tr>
<tr><td>8.</td><td>CONTINUOUS INFUSIONS</td><td colspan="4">YES: CONTINUOUS infusion option enabled in PROTOCOL set up.
NO: Continuous infusions are not available. Option not available in PROTOCOL set up.</td></tr>
<tr><td>9.</td><td>LOADING DOSES</td><td colspan="4">YES: LOADING DOSE option enabled in PROTOCOL set up. To activate this option, NEW PATIENT is confirmed. Start the PCA.
NO: Loading doses are not available.</td></tr>
<tr><td>10.</td><td>MAX DOSE LIMITS</td><td colspan="4">YES: MAX LIMIT option enabled in PROTOCOL set up.
NO: Dose limits are not available. Option not available in PROTOCOL set up.</td></tr>
<tr><td>11.</td><td>VARIABLE DOSE RATES</td><td colspan="4">YES: PCA DELIVERY option enabled in PROTOCOL set up
NO: Variable PCA doses not available.</td></tr>
<tr><td>12.</td><td>COMMS PUMP IDENTITY</td><td colspan="4">Set pump identity for use with remote communications (000 to 127).</td></tr>
<tr><td>13.</td><td>COMMS ENABLED</td><td colspan="4">YES: RS232 communications enabled.
NO: RS232 communications disabled.</td></tr>
<tr><td>14.</td><td>NURSE CALL</td><td colspan="4">YES: Nurse Call feature enabled (hardware feature allowing pump to communicate with the hospital's nurse call system, typically linked to central nurse's station).
NO: Nurse Call feature disabled.</td></tr>
<tr><td>15.</td><td>NURSE CALL INVERTED</td><td colspan="4">YES: Nurse call hardware output is inverted.
NO: Nurse call hardware output normal.</td></tr>
<tr><td>16.</td><td>CONTINUOUS PRINT</td><td colspan="4">YES: Enables printing of events as they occur.
NO: Continuous printing disabled.</td></tr>
<tr><td>17.</td><td>DEFAULT SYRINGE</td><td colspan="4">Set default syringe type:
BD PLASTIPAK
IVAC
TERUMO
B. BRAUN OMNIFIX
MONOJECT
R.R PRONTO
BD WORLDWIDE
ONCE
FRESENIOUS INJECT.
RAPIJECT
PHARMA-JECT
BD PRECISE
BRAUN PERFUSOR*
JANPOL*
* with options kit fitted</td></tr>
</table>

General Options (251) *continued*

GENERAL OPTIONS *(continued)* Software version: V3R2		
Option	**Description**	
18. LOCK SYRINGE TYPE	**YES:** **NO:**	**Syringe type locked to default syringe type (as set in previous option).** **Syringe type not locked to default syringe type - can be changed.**
19. QUIET MODE	**YES:** **NO:**	**Pump in quiet mode.** **Pump in normal mode.**
20. GENERIC DRUG ENABLED	**YES:** **NO:**	**Generic drug (indicated by ⟵XXX DRUG⟶) is available when modifying protocols. See 'Preset Protocol Set Up' for further details.** **Generic drug is not available.**
21. MAX DOSE LIMIT ALARM	**YES:** **NO:**	**Pump alarms when the maximum dose limit is exceeded.** **Pump does not alarm when the maximum dose limit is exceeded.**
22. MIX MASS & VOL MODES	**YES:** **NO:**	**Drugs can be set in either Mass mode or Volume mode.** **All drugs and protocols are in Mass mode only.**

Notes:

1) For pumps with software version V2R8 or earlier, the options may vary, or will not be available. Refer to the relevant *DFU* for comprehensive information.

2) For default settings, refer to Appendix C, 'Configured Options and Drug Protocol Records'.

Preset Protocol Set Up (251)

The number of protocols available for use is configured in **GENERAL OPTIONS**.

1. Enter the access code **251** to display the **CONFIGURATION OPTIONS** menu.
2. Select **PROTOCOL DEFAULT SET-UP** using the buttons then select **ENTER**. **PROTOCOL DEFAULT A** is displayed.
3. Select **NEXT PROTOCOL** to choose another protocol or select **MODIFY PROTOCOL** to modify the current protocol, as detailed below. Alternatively, select **QUIT** to return to the **CONFIGURATION OPTIONS** menu.
4. Use the buttons to move up/down the list of parameters (see table below).
   - To enter a parameter, highlight it and select **ALTER**. Where relevant, the limits set in **DRUG NAMES AND SAFETY LIMITS** are displayed**.**
   - Use the buttons to toggle/select a value then select **OK** to confirm. Alternatively, use **CANCEL** to quit.
   - Select **OK** at any time to return to **PROTOCOL DEFAULT**.
5. When set up is complete, switch **LOCK 1** to the **OFF** position.

PROTOCOL DEFAULT SET-UP	
PROTOCOL parameter	**Description**
DRUG NAME	**Select the drug. Use the buttons to step through the names of the available drugs (as set up in DRUG NAMES AND SAFETY LIMITS).** **If enabled, a generic drug is available, indicated by ⟵MASS DRUG⟶ or ⟵VOL DRUG ⟶ (only available when MIX MASS & VOL MODES option is enabled).** **Important: The parameter limits of the generic drug are automatically set to the maximum value.**
DRUG CONC.	**Set the drug concentration between the minimum/maximum limits set for the selected drug.**
PCA DOSE	**Set the PCA dose between the minimum/maximum limits set for the selected drug.**
LOCKOUT PERIOD	**Set the lockout period between the minimum/maximum limits set for the selected drug.**
OCCLUSION LEVEL	**Set the occlusion level (L0 to L10).**
CONTINUOUS*	**Set the continuous rate, below the maximum continuous rate limit set for the selected drug, or 35ml/h (for syringes >50ml), 20ml/h (for syringes <50 ml and all syringes on pumps with V2R8 or below), whichever is lowest.**
LOADING DOSE*	**Set the loading dose, below the maximum loading dose set for the selected drug.**
MAX LIMIT*	**Set maximum dose, below the maximum max dose set for the selected drug.**
LIMIT DURATION*	**Set the maximum cumulative period (1 to 8 hours).**
PCA DELIVERY*	**Set the PCA delivery rate. STAT rate 100 ml/h (80 ml/h for 20 ml syringes), or set by delivery time (1 to 60 minutes).**
*** These options are not available if disabled.** **Note: For pumps with software version V2R8 or earlier, the options may vary, or will not be available. Refer to the relevant *DFU* for comprehensive information.**	

Syringe Range Selection (359)

Configure the pump to use one of the three standard disposable syringe ranges, as listed in the table below.

Ensure that the required options kit is fitted to the pump before selecting the syringe range.

1. Enter the access code **359**. See 'Entering an Access Code' for instructions. The display will show the current syringe range.
2. Use the buttons to select the required syringe range:

Syringe Range	Syringe Types	Size (ml)
UNIVERSAL	BD PLASTIPAK	20, 30, 50
	IVAC	50, 100
	TERUMO	20, 30, 50
	BRAUN OMNIFIX	20, 30, 50
	MONOJECT	20, 30, 50
	RR PRONTO	20, 30, 50
	BD WORLDWIDE	20, 30, 50
	ONCE	50
	FRESENIUS INJECT.	50
	RAPIJECT	50
	PHARMA-JECT	50
	BD PRECISE	20, 50
BRAUN PERFUSOR	B BRAUN PERFUSOR	50
JANPOL	JANPOL	50

3. Turn **LOCK 1** to **OFF** to complete the configuration.

Language Selection (359)

Configure the pump's language used for messages shown on display.

1. Enter the access code **359**. See 'Entering an Access Code' for instructions. The display will show the current syringe range.
2. Press **NEXT** to go to language selection.
3. Use the buttons to select the required language:
4. Turn **LOCK 1** to **OFF** to complete the configuration.

Setting the End of Infusion (EOI) Position

Use the following procedure to check and to set the EOI point.

1. Enter the access code **126** (see 'Entering an Access Code' for instructions).
2. Select **NEXT** to step through the self-test routines until the display reads **EOI opto: x** (where x is the current status of the EOI detector).
3. Move the plunger holder to the right. The display will read **EOI opto: 0**
4. Load an empty 50ml syringe (see list of suitable syringes below), squeeze the finger grips and move the plunger holder slowly to the left.
5. Check the display switches from **0** to **1**. The position at which the display changes is the EOI point and it depends on the type of syringe in use. Use the following table to check the EOI point:

Syringe Type	Syringe Size (ml)	EOI Point (ml)
BD Plastipak	50	5.5
IVAC	50	6.0
Terumo (US manufactured)	50	6.0
Braun Omnifix	50	5.0
Monoject	50	5.5
R.R Pronto	50	7.5
Rapiject	50	3.0
BD Worldwide	50	6.5
Once	50	4.5
Fresenius Inject	50	5.0
Braun Perfusor	50	3.0
Janpol	50	3.0

6. If necessary, separate the lower and upper case of the pump (see Chapter 6, 'Spare Parts Replacement Procedures') and adjust the position of the EOI actuator on the bottom of the carriage to the desired position, so that the EOI status changes from **0** to **1** at the position set out in table above.
7. Move the plunger holder and observe that the display changes from **0** to **1** as the syringe passes the EOI position.

   If it does not repeat procedure from Step 3.
8. Fit and fasten the case halves together and check the EOI point again.

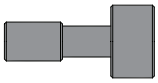
Calibration Procedures

Syringe Size Calibration (243)

To calibrate the syringe size detection system, follow the two-point calibration procedure described below.

Calibration tools required:

1000TG00055 (Syringe Sizing Spacer)



1000TG00055

Calibration procedure:

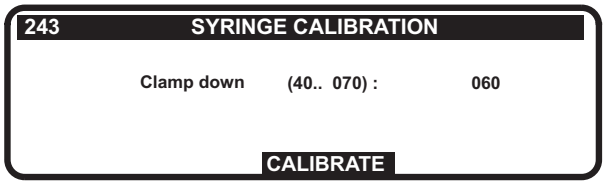
- Enter the access code **243**.
- Fit calibration tool into position on the pump and close the clamp, following Steps 1 - 3 below.

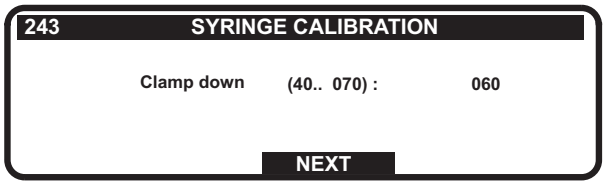
  At each step, **CALIBRATE** is displayed if value is within tolerances.
  Select **CALIBRATE** to store calibration point. Select **NEXT** to continue to the next screen.

  Notes:

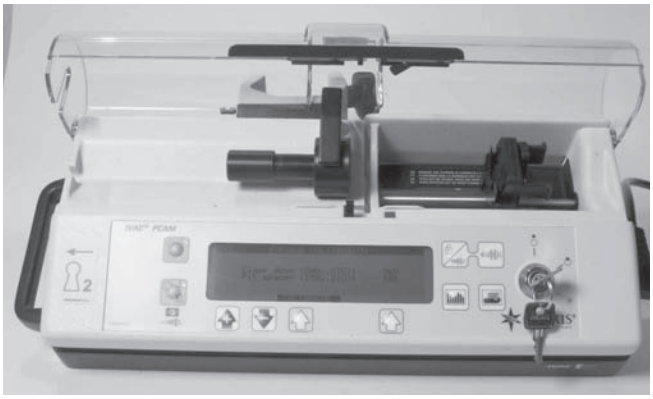
  1) If **CALIBRATE** is not displayed, check for correct positioning of calibration tool. If calibration cannot be performed, repairs to pump may be necessary.
  2) The calibration values shown below are for illustrative purposes only.

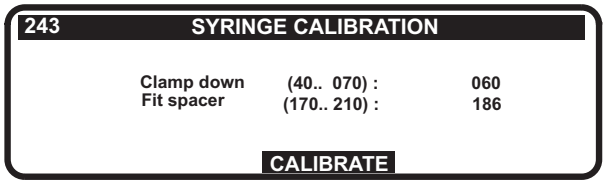
Step 1: Position the *narrow* end of the calibration tool under the syringe clamp

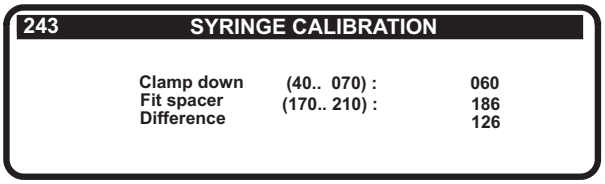




Step 2: Re-position the calibration tool with the *wide* end under the syringe clamp







Step 3: Complete calibration

Switch **LOCK 1** to the **OFF** position to complete the calibration sequence.

Confirmatory Check - To confirm that the syringe sizing calibration has been performed correctly, select a syringe (preferably 50ml), load and confirm the correct syringe type. Verify that the correct syringe size is detected and displayed.

Calibration Procedures *(continued)*

Occlusion Calibration (717)

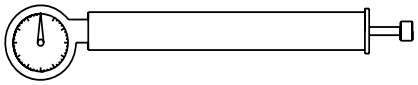
To set the pump occlusion alarm level, follow the calibration procedure described below. To test the occlusion alarm levels, see 'Occlusion Alarm Levels Test' in Chapter 3.

To convert Kilograms of Force (KgF) to Newtons (N) multiply by 9.806650. For example 10 KgF = 98.07N.

Excessive force will damage the plunger mechanism. Do not apply more than 10 KgF ±0.05 KgF to the plunger mechanism at any time.

Calibration tools required:

0000TG00020 (shown) or 0000TG00200 and 0000JG00014



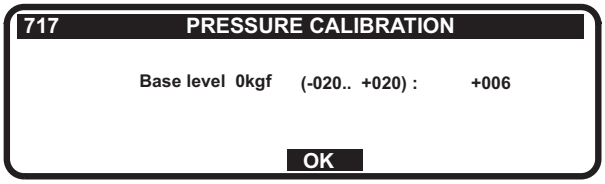
Calibration procedure:

- Enter the access code **717**.
- Select the **OK** option to start the drive, following Steps 1-5 below.

Notes:

1) If **CALIBRATE** does not appear in display, check for correct positioning of tool. If calibration cannot be performed, repairs to the pump may be necessary.
2) The calibration values shown on the pump displays are for illustrative purposes only.

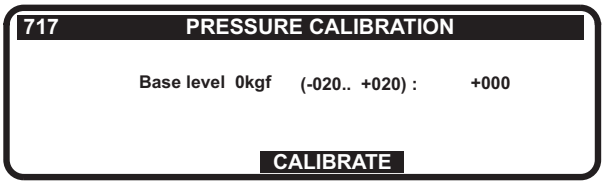
Step 1: Start drive (without calibration tool fitted)



Allow drive to run for approximately 30 seconds to enable the zero pressure level to settle.

Step 2: Base level

Check pressure reading is within the range displayed.

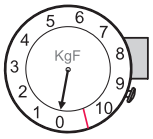


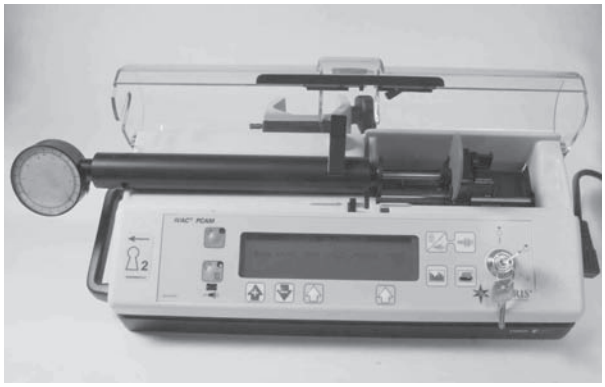
- **If necessary, open up the pump and adjust pot RV1 on the Control PCB until it falls within the range**
- **Strive for a pressure reading as close as possible to +000**

Calibration Procedures *(continued)*

Occlusion Calibration (717) *continued*

Step 3: Fit calibration tools (0KgF)



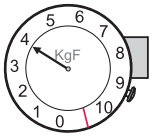


717	PRESSURE CALIBRATION	
Base level 0kgf	(-020.. +020) :	+000

NEXT

Step 4: Test gear 4.0 KgF

Allow pump to run until the dial gauge on the test gear reads 4Kgf.



717	PRESSURE CALIBRATION	
Base level 0kgf	(-020.. +020) :	+000
Test gear 4.0kgf	(+050.. +100) :	+062

CALIBRATE

717	PRESSURE CALIBRATION	
Base level 0kgf	(-020.. +020) :	+000
Test gear 4.0kgf	(+050.. +100) :	+062
Difference 0 kgf	to 4.0 kgf :	+062

Step 5: Complete calibration

Switch **LOCK 1** to the **OFF** position to complete the calibration sequence.

Battery Charge Circuit Verification

Replacement Power Supply PCBs are supplied with the charging voltage set to the correct value. The procedure below can be followed in order to check the DC voltage setting if deemed necessary.

Equipment required: Oscilloscope

1. Ensure that the pump is swtiched OFF and is disconnected from the AC power supply.
2. Access the pump, see Chapter 6, 'Spare Parts Replacement Procedures' for instructions.
3. Disconnect the battery connector from the Power Supply PCB and connect the oscilloscope to PL3 (0V to pin 1).
4. Set the oscilloscope range to 0 to 7 VDC.
5. Connect the pump to AC power supply.
6. Adjust RV1 on the Power Supply PCB until the peak voltage level displayed on the oscilloscope is 7.0 ± 0.1 VDC.
7. Reseal RV1.
8. Disconnect the AC power supply, remove the oscilloscope connections and refit the battery connector.

Clearing Internal RAM (611)

Warning: Do not clear the RAM unless absolutely necessary because all the calibration and configuration in the pump will be cleared.

If the internal RAM or its associated battery is replaced on the Control PCB, or if the pump fails with a 'CODE 5' RAM error it will be necessary to do the following:

- Clear the internal RAM:
  1. Enter the access code **611**.
  2. Select **ENTER** and wait for the RAM to be cleared.
  3. When the message **RAM CLEARED** appears, switch **LOCK 1** to the **OFF** position.
- Fully calibrate pump. Perform each of the two calibration procedures, as described in this chapter.
- Reconfigure the pump:
  - Set Configuration, Drugs and Safety Limits and Protocols (it may be possible to use the Teach/Learn facility, see Chapter 3, 'Routine Maintenance' for instructions)
  - Enter the access code **359** and set syringe range and language
  - Enter the access code **376** and set service date
- Carry out Performance Verification Procedure (PVP). See Chapter 3, 'Routine Maintenance' for instructions.

Chapter 3

Routine Maintenance

In this chapter

Introduction

For routine maintenance, the following tests and performance verification procedure should be performed in addition to the tasks described in the section 'Physical Inspection and Clean'.

Refer to the relevant *DFU* for the recommended routine maintenance period.

Self-Test Procedure (123)

The self-test procedure is designed to allow confirmation of many of the pump functions, defaults and calibrations without requiring internal inspection.

1. Enter the access code **123**. See 'Entering an Access Code' in Chapter 2 for instructions.
2. The pump now proceeds through a series of tests. Press the **NEXT** softkey to move to the next test.

   Refer to the table below for details of each test.

Important: If the pump fails the test sequence at any stage, it should be taken out of service and inspected by a qualified service engineer.

Test	Display	Description/Action
Review software setup	**Software revision** **Program CRC** **Language** **Hospital name**	**Displays software version, program CRC, language and hospital name.**
Review syringe data	**Syr range** **Syr cal** **Occ cal**	**Displays syringe range, syringe and occlusion calibration figures.**
Internal PSU voltage	**Internal PSU voltage:** **_ . _ _ V**	**On mains supply: 9.00V approximately** **On battery supply: 5.20V - 6.50V**
Audible: Alarm	**Audible alarm**	**Check that the alarm sounds continuously.**
Visual: Display and Backlight	**Display test** **Backlight**	**Check that the display dots are an even tone as they all go on full backlight, then to dim, then turn off.**
Touch panel buttons	**Press S1** **01** **06** **02** **07** **03** **08** **04** **09** **05** **10**	**Press buttons in turn from START (01) to PURGE (10).**
Visual: LED Indicators	**LEDS flashing**	**Check that the STOP and START LED'S are flashing.**
Declutch switch	**Declutch:**	**Squeeze plunger holder finger grips and check that the display alternates between 1 (engaged) and 0 (disengaged - finger grips squeezed together).**
Near End of Infusion	**EOI opto:**	Starting with an empty, extended 50ml syringe on the pump, squeeze the finger grips and move the plunger holder slowly to the left. Check the display switches from **0** to **1**. The position at which the display changes (EOI point) depends on the type of syringe in use. See 'Setting the EOI Position' in Chapter 2. for values.
Linear Grid	**Grid opto:**	**Squeeze the plunger holder grips together and slide the mechanism to the right. Slowly move the syringe plunger to the left and check the display alternates between 0 (OPTO over slot) and 1 (OPTO over bar).**
Plunger Detector	**Plunger opto:**	Press plunger plate button. Check the display switches from **1** (no syringe plunger fitted) to **0** (syringe plunger fitted).
Motor Encoder	**Motor/encoders:**	**Motor is pulsed while encoders are tested. Motor moves forwards and backwards as encoders pass.**
Cover Detect	**Cover detect:**	Open and close the cover. Check that the display changes from **0** (cover open) to **1** (cover closed).

Self-Test Procedure (123) *continued*

Test	Display	Description/Action
Syringe Size Detection	Syringe pot:	Lift the syringe clamp and check that the values displayed increase within the normal range (approx. 045 to 215).
Pumping Pressure Detection	Beam value:	Remove the syringe and confirm that the value displayed is within normal range (-020 to +020). Gently press back on the plunger holder and watch the value increase.
Patient Handset	Handset:	Connect handset and check that the display changes from OFF to ON when the button is pressed. Also check that the handset LED lights up then goes off.
Key Switch	Key switch:	Turn key from SET position to RUN position and the check the display changes accordingly.
Nursecall	Nurse call on/off/on	Check for audible clicks of the relay.
Configuration summary	Summary of configured options	Select the NEXT option and scroll to the next page of configured options, then to normal operation.

Upgrading Software

Upgrade of the IVAC® PCAM Syringe Pump software to V2R8 or greater is recommended when serviced.

Perform upgrades by acquiring the software upgrade kits specified in spare parts listings.

Equipment required: Software upgrade kit (includes EPROM fitting and removal instructions)

Software Upgrade Kits Available

Part Number	Description
5000SP00049	V3R2 software + DFU English/French/German
5000SP00053	V3R2 software + DFU English/French/Dutch
5000SP00054	V3R2 software + DFU English/Spanish
5000SP00055	V3R2 software + DFU English/Italian/German
5000SP00056	V3R2 software + DFU English/Swedish

Event Log Download

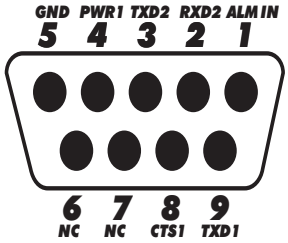
The Event Log can be downloaded directly to a PC using Microsoft HyperTerminal.

Note: The procedure below uses Microsoft HyperTerminal - Microsoft Windows XP Professional.

Equipment required:

- RS232 cable, 9-pin D type
- PC running Microsoft Windows

Cabling connections:



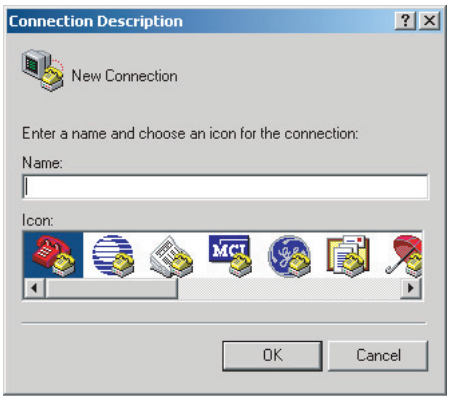
Pump		PC	
Male		Female	
Pin 5	GND	Pin 5	GND
Pin 8	CTS1	Pin 4	PWR1
Pin 9	TXD1	Pin 2	RXD2

Pump Set Up

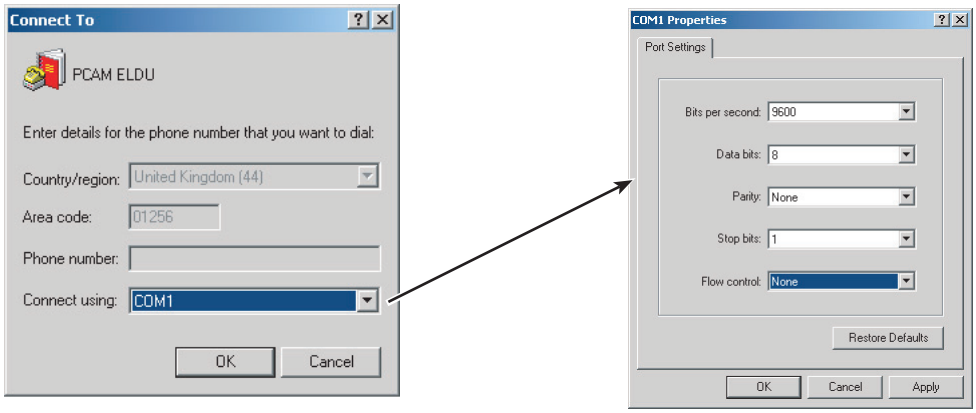
1. Connect the RS232 cable to the serial port of the pump and the COM port of the PC.
2. Enter access code **794**. See 'Entering an Access Code' in Chapter 2 for instructions. This enables access to the full Event Log.
3. Turn the pump OFF.
4. Turn the pump ON. Select **NO** to retain previous patient data.
5. Press the button four times to display the Event Log. Use the buttons to position the cursor at the start point of events to be downloaded.

Set Up HyperTerminal on your PC

1. Open **HyperTerminal** on your PC. Click **Start**, point to **All Programs**, point to **Accessories**, point to **Communications**, and then click **HyperTerminal**. Enter a HyperTerminal connection name, for example, **PCAM ELDU**, select an icon and click **OK**.
2. Select **COM1** and click **OK** (leaving **Country/region** and **Area code** as default). Ensure **COM1** is not already pre configured, for



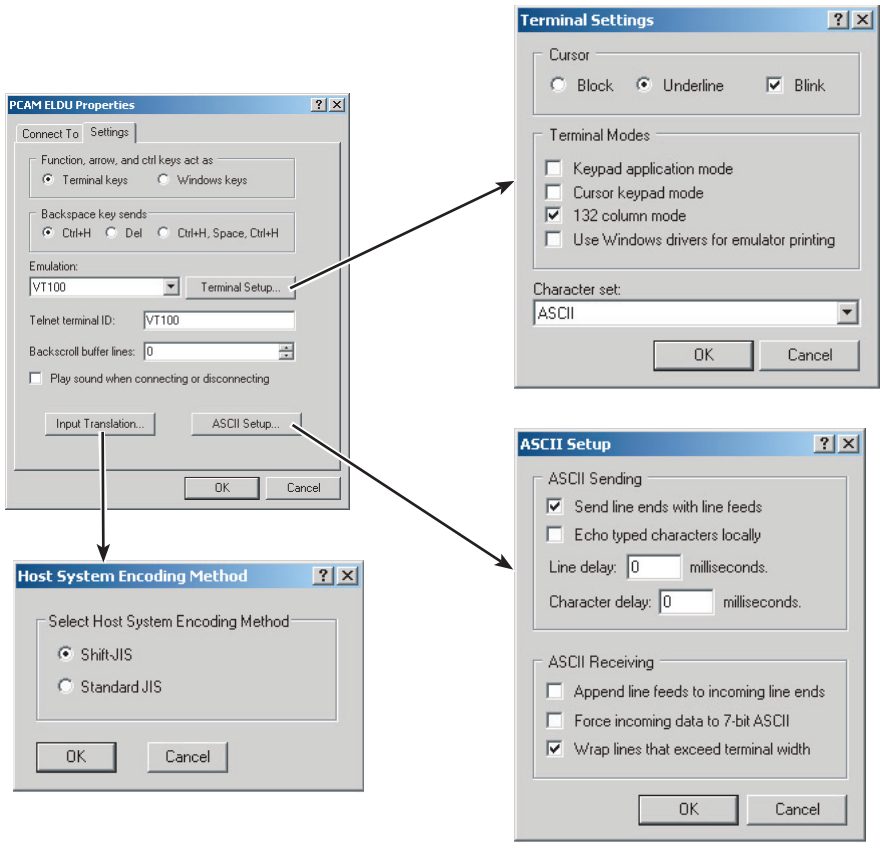
example, pre configured for a hand-held PC. Configure **COM1 Properties** as shown below, click **Apply** then **OK**.



Event Log Download *(continued)*

Set Up HyperTerminal on your PC *(continued)*

3. On the **File** menu, select **Properties.** Select the **Settings** tab then configure settings as shown below. Click **OK** to close the **Properties** window.



4. On the **Transfer** menu, select **Capture Text**. Enter file name and desired location for data to be saved to (example, D:\DATA\PCAM EVENTLOG). Click **Start**.
5. Press the  button on the pump.
6. Once finished, the Event Log data will be displayed on the PC screen.
7. Save and Close HyperTerminal.
8. Locate the saved file (example D:\DATA\PCAM EVENTLOG) and open it using **WordPad**. Save the WordPad document as a unicode text document:
   On the WordPad **File** menu, select **Save As**. Enter a **File name** (i.e. pump serial number). Select file type **(Unicode Text Document)** from the drop-down box then click **Save**.

Example Event Log Download

08/06/04 10:07 ---- POWER ON ---- 0 ug
08/06/04 10:07 NEW PATIENT 0 ug
08/06/04 10:07 PROTOCOL CONFIRMED 0 ug
08/06/04 10:07 DRUG UFTU 1
08/06/04 10:07 DRUG CONC. 1.0 mg/ml
08/06/04 10:07 PCA DOSE 1.0 mg
08/06/04 10:07 LOCKOUT 5 min
08/06/04 10:07 OCCLUSION ALARM 4
08/06/04 10:07 CONTINUOUS 0 ug/h
08/06/04 10:07 DOSE LIMIT 50.0 mg
08/06/04 10:07 LIMIT PERIOD 4 h
08/06/04 10:07 50 ml BD PLASTIPAK
08/06/04 10:07 PCAM START 0 ug
08/06/04 10:07 GOOD DEMAND 0 ug

Example *(continued)*

08/06/04 10:07 PCAM STOP 90 ug
08/06/04 10:07 PCAM START 90 ug
08/06/04 10:08 LOCKOUT START 1.00 mg

Teach Learn

A pump can be configured/reconfigured by transferring data from one pump (Teacher pump) to another pump (Learner pump) via the serial port.

Equipment required

- RS232 cable (1000SP01008)
- Two pumps

  Recommendations:

  1) Use a 'master' pump (with the RAM cleared - test 611 - then fully reconfigured) from which to undergo Teach/Learn
  2) To ensure successful data transfer, use two pumps with the same version of software

Procedure

1. Connect the Teacher pump to the Learner pump using the RS232 cable.
2. On the Teacher pump, enter the access code **168** and on the Learner pump, enter the access code **167**.
3. While in progress, the data being transferred is listed by item number on the pump display, marked with either **Pass** or **Fail** indicating whether or not the data was transferred successfully. Where an item is marked as **Fail**, the original setting is not changed. The tables below list the data items.

Item	Description
0	General configuration
1	Protocol A
2	Protocol B
3	Protocol C
4	Protocol D
5	Protocol E
6	Protocol F
7	Protocol G
8	Protocol H
9	Protocol I
10	Drug 1 data
11	Drug 2 data

Item	Description
12	Drug 3 data
13	Drug 4 data
14	Drug 5 data
15	Drug 6 data
16	Drug 7 data
17	Drug 8 data
18	Drug 9 data
19	Drug 10 data
21	Protocol J
22	User modified protocol - Protocol X

4. When the process has finished, select the **OK** option.

Possible reasons for Teach/Learn failure:

- Software versions are different, see 'Recommendations' above
- Loose cable connection or faulty RS232 cable

Once Teach Learn is complete, all configuration settings on the Learner pump, including DRUG NAMES AND SAFETY LIMITS, must be checked against the Teacher pump (original source).

Linear Speed Test

The linear accuracy of the pump can be verified by measuring the time the plunger holder takes to travel a specified distance. The distance travelled is measured using a dial indicator, mounted in place of the syringe, and the elapsed time can be measured using a stop watch.

Test gear required: 1000TG00080, 0000TG00032 and 0000JG00014

1. Declutch the drive mechanism and move the plunger holder to the right.
2. Fit the linear test gear 1000TG00080 and 0000JG00014 (plunger protect) to the pump, and 0000TG00032 (magnet) to the cover clip position and move plunger holder towards the dial gauge until it is a about 3mm clear of the probe.
3. Set up the pump and perform the test in either PCA mode or in Continuous mode (as described below). Use the most appropriate method, depending on the pump configuration.

PCA mode method

- Switch **LOCK 1** to the **SET** position. Set PCA delivery to STAT, PCA dose to 20mg then switch **LOCK 1** to the **RUN** position.

  Note: The use of a generic drug is recommended, for example, ◄—**MASS DRUG**—►. If necessary, enable the **GENERIC DRUG** option and the **VARIABLE DOSE RATES** option (for PCA delivery) in **GENERAL OPTIONS**, access code **251**, see Chapter 2 for instructions.
- Confirm syringe type 'BD Plastipak' then press handset to start infusion.
- Allow the pump to run until it touches the probe and then using a stop watch, time the travel over a distance of 15.00mm. Check that the pump is travelling at the correct speed, within the range of 4mins 50secs to 4mins 58secs. If the time falls outside the range (or the movements of the dial are jerky) then the pump requires further investigation.

IMPORTANT: Where configuration settings and/or protocol parameters are changed, ensure each one is changed back to the original value on completion of the test.

Continuous mode method

- Switch **LOCK 1** to the **SET** position, set the pump to run at a continuous rate of 20ml/h then start the pump. Allow the pump to run until it touches the probe and then using a stop watch, time the travel over a distance of 10.00mm.
- Using the values specified in the 'Linear Accuracy Table' below, check that the pump is travelling at the correct speed. If the time falls outside the range (or the movements of the dial are jerky) then the pump requires further investigation. Note: Syringe constants are also provided for a combination of rates and syringe sizes. See next section.

4. Switch **LOCK 1** to the **OFF** position and remove the test gear.

Linear Accuracy Table (Continuous mode, travel distance 10.00mm)				
Syringe Type	**Size (ml)**	**Flow Rate (ml/h)**	**Expected Time (min:sec) Software V2R8 or lower**	**Expected Time (min:sec) Software V3R2 or higher**
BD Plastipak	**50**	**20**	**16m 21s ± 10s**	**16m 25s ± 10s**
B. Braun Perfusor	**50**	**20**	**18m 12s ± 11s**	**18m 19s ± 11s**
Janpol	**50**	**20**	**17m 51s ± 11s**	**17m 51s ± 11s**

Note: It is only necessary to perform the test using one syringe type, 'BD Plastipak' is recommended.

Syringe Constant Values

The following information is for reference purposes only.

Syringe Constants			
Syringe Type	**Size (ml)**	**Constant (mm per 1ml) Software V2R8 or lower**	**Constant (mm per 1ml) Software V3R2 or higher**
BD Plastipak	**50**	**1.84**	**1.83**
	30	**2.79**	**2.77**
	20	**3.56**	**3.59**
BD Precise	**50**	**Not applicable**	**1.54**
	20	**Not applicable**	**3.16**
Terumo	**50**	**1.54**	**1.51**
	30	**2.41**	**2.38**
	20	**3.18**	**3.14**
Braun Omnifix	**50**	**1.68**	**1.64**
	30	**2.61**	**2.64**
	20	**3.20**	**3.21**
B. Braun Perfusor	**50**	**1.65**	**1.64**
Fresenius Inject.	**50**	**1.49**	**1.55**
Monoject	**50**	**1.80**	**1.83**
	30	**2.32**	**2.31**
	20	**3.19**	**3.15**
Rapiject	**50**	**1.72**	**1.73**
RR Pronto	**50**	**1.49**	**1.49**
	30	**2.28**	**2.28**
	20	**2.83**	**2.83**
ONCE	**50**	**1.64**	**1.64**
IVAC	**100**	**.89**	**.92**
	50	**1.84**	**1.81**
BD World Wide	**50**	**1.84**	**1.84**
	30	**2.79**	**2.79**
	20	**3.53**	**3.53**
Janpol	**50**	**1.68**	**1.68**

Occlusion Test

Test equipment: 0000TG00020 (or 0000TG00200), 0000TG00032 and 0000JG00014.

1. Declutch plunger holder and move to the right.
2. Fit occlusion test gear 0000TG00020 and 0000JG00014 (plunger protect) to the pump and 0000TG00032 (magnet) to the cover clip position, move the plunger holder towards the test gear actuator pad, leaving the plunger holder just clear of the actuator pad.

Fit the Test Gear

3. Set up the pump and perform the test in either PCA mode or in Continuous mode (as described below). Use the most appropriate method, depending on the pump configuration.

IMPORTANT: Where configuration settings and/or protocol parameters are changed, ensure each one is changed back to the original value on completion of the test.

PCA mode method

- Switch **LOCK 1** to the **SET** position. Set PCA delivery to STAT, PCA dose to 20mg then switch **LOCK 1** to the **RUN** position.

  Note: The use of a generic drug is recommended, for example, ⟵**MASS DRUG**⟶. If necessary, enable the **GENERIC DRUG** option and the **VARIABLE DOSE RATES** option (for PCA delivery) in **GENERAL OPTIONS**, access code **251**, see Chapter 2 for instructions.
- Confirm syringe type 'BD Plastipak' and occlusion alarm level to L-4 then press handset to start infusion. Note: If necessary, change the Syringe Range to **UNIVERSAL** by entering access code **359**.
- Run pump and check that the force at alarm is within the range of 3.1 KgF to 3.9 KgF. If it is outside the range then re-calibrate (see 'Occlusion Calibration' in Chapter 2) and re-test.

Continuous mode method

- Set the pump to run at a continuous rate of 20ml/h with occlusion alarm level L-4 then start the pump.
- Run pump and check that the force at alarm is within the range for the syringe type in use. See 'Occlusion Test Force Ranges' on the following page. If it is outside the range then re-calibrate (see 'Occlusion Calibration' in Chapter 2) and re-test.

4. Switch **LOCK 1** to the **OFF** position and remove the test gear.

Occlusion Test *(continued)*

Occlusion Test Force Ranges (Continuous mode method)			
Syringe Type	**Size (ml)**	**Alarm Level (KgF)**	**Force Range**
BD Plastipak	**50**	**3.5 (see Note 2 below)**	3.1 KgF to 3.9 KgF
Terumo	**50**	**6.5**	6.0 KgF to 7.0 KgF
Braun Omnifix	**50**	**4.1**	**3.7 KgF to 4.5 KgF**
B. Braun Perfusor	**50**	**4.0**	3.6 KgF to 4.4 KgF
Fresenius Inject.	**50**	**5.7**	5.3 KgF to 6.1 KgF
Monoject	**50**	**3.9**	3.5 KgF to 4.4 KgF
Rapiject	**50**	**3.3**	2.8 KgF to 3.7 KgF
RR Pronto	**50**	**5.7**	5.2 KgF to 6.2 KgF
ONCE	**50**	**3.9**	3.5 KgF to 4.4 KgF
IVAC	**50**	**3.9**	3.5 KgF to 4.4 KgF
BD World Wide	**50**	**3.6**	3.2 KgF to 4.1 KgF

Notes:

1) It is only necessary to perform the test using one syringe type, 'BD Plastipak' is recommended.

2) Alarm level (for BD Plastipak only) is 3.9 KgF ± 0.4 KgF on pumps with software below V2R6.

Potential Equalisation Terminal Resistance Test (PE Test)

Equipment required: DVM Resistance Meter

1. Connect one lead from the DVM resistance meter to the PE terminal on the pole clamp of the pump and the other to the pump leadscrew. Check that the settled value of resistance is less than 20MΩ.
2. Move the lead from the leadscrew and repeat the check with the lead to the outer tube. Check that the settled value is less than 20MΩ.
3. If the value of either of the two readings is greater than 20MΩ the pump fails this test and must be removed from service for further investigation.

Battery Maintenance

Maintenance:	**To achieve optimum operation of the pump whilst being used on battery power, it is recommended that a battery test (see 'Battery Test' below is performed to ensure that the pump will operate correctly on battery power. Where it is not possible to run a battery test, it is recommended that the battery is replaced every 2 years.**
Charging:	**Typically, a new battery will take approximately 24 hours from discharge to 100% charge.**
New Batteries:	**Where a battery is not tested prior to installation, it is recommended where possible that a battery test is performed.**
Battery Test:	**Run the pump on battery power at the rate of 5 ml/h in CONTINUOUS mode, for a minimum of 4 hours (2.8Ah battery) or 6 hours (3.4 Ah battery). This test should be performed annually, or more frequently as required (e.g. where charge retention is critical to pump operation).**
Storage:	**The pump should be fully recharged after discharge before storage, and at 3 month intervals during storage.**
Battery Life:	**The internal rechargeable sealed acid lead battery will retain charge if maintained correctly. Charge retention will degrade over time. The internal battery should be replaced every 3 years, or if the pump fails the battery test.**

Physical Inspection and Clean

To ensure the pump remains in good operating condition, it is important to keep it clean and carry out the routine procedures described below. All servicing should only be performed by a qualified service engineer.

- Thoroughly clean external surfaces of the pump, by wiping over with a cloth lightly dampened with warm water and a standard disinfectant/detergent solution.

Before cleaning always switch OFF and disconnect from the AC power supply. Never allow fluid to enter the casing and avoid excess fluid build up on the pump.
Do not use aggressive cleaning agents as these may damage the exterior surface of the pump.
Do not steam autoclave, ethylene oxide sterilise or immerse this pump in any fluid.

- Check that labels are flat, legible and fully adhered. Replace as necessary.
- Inspect case components for damage and replace if necessary.
- Inspect the pole clamp for damage and check that it functions correctly.
- Inspect the AC power supply plug and cable for damage.
- Inspect the patient handset for damage.

Performance Verification Procedure

Model / Serial Number:		**Service Order / Inventory Number:**		
Hospital Name / Reference:		**Software Version:**		
INSPECTION	**Physical inspection and clean**			
UPDATES	**Recommended when serviced**	**UPDATE REF:**	**Fitted ✓**	**Not fitted / Not Applicable ✓**
	Fit V2R8 (or above) software to any pump fitted with previous software	**CH3**		
	Any Mk1 Control Boards will require replacement	**-**		
	Bond the syringe clamp assembly on pumps with serial numbers 5001-00083 to 5001-02910	**CH6**		
SELF TEST *CH3* **123**	**Check all functions in self-test** Check and adjust time and date as required (251)			
INFUSING *DFU*	**Alarms functionality check** **COVER OPENED, PLUNGER LOCATION, SYRINGE LOCATION, HANDSET REMOVED, DRIVE DISENGAGED, NEAR END OF SYRINGE, SYRINGE EMPTY** **Ensure pump works on battery and AC mains**			
VERIFICATION TESTS *CH3*	**Linear speed test** **PCA MODE METHOD: Fluid delivery set to STAT, PCA dose to 20 mg. Press handset to start infusion. Pump set to syringe type BD Plastipak 50 for a distance of 15 mm, 4 mins 50 secs to 4 mins 58 secs** **OR** **CONTINUOUS MODE METHOD: Pump set to continuous rate of 20 ml/h, syringe type BD Plastipak 50 for a distance of 10 mm, 16 mins 21 secs ± 10 secs**	**_____ mins _____ secs**		
	Occlusion test **PCA MODE METHOD: Fluid delivery set to STAT, PCA dose to 20 mg, Press handset to start infusion. Pump set to syringe type BD Plastipak 50, occlusion alarm level L-4, 3.1 KgF to 3.9 KgF** **OR** **CONTINUOUS MODE METHOD: Pump set to continuous rate of 20 ml/h, syringe type BD Plastipak 50, occlusion alarm level L-4, 3.1 KgF to 3.9 KgF**	**_____ KgF**		
	Battery test **Run pump on battery power at the rate of 2ml/h in CONTINUOUS mode, for a minimum of 4 hours (2.8Ah battery) or 6 hours (3.4 Ah battery)**			
SETUP	**Set rate to zero (or lowest value possible), Clear Volume Infused and VTBI** **Clear Error / Alarm / Battery logs (as required)**			
ELECTRICAL SAFETY TESTS	**Class II Type CF** *Alternatively attach printed test results* **Insulation Resistance > 50 Megohms** **Enclosure Leakage Current <= 100 µA**	**_____ MΩ** **_____ µA**		
Verification Performed By	**Sign**	**Print**	**Date**	

CHX **indicates the chapter number in the Technical Service Manual (TSM) - 1000SM00017.**
E.G. *CH3* **= Refer to TSM Chapter 3.** *DFU* **= Refer to the relevant DFU.**

NOTE: The content of this Performance Verification Procedure is accurate at the time of issue of this TSM and is based on PVP 100 Issue 2.

Chapter 4

Troubleshooting

In this chapter

Introduction

Use this troubleshooting guide to help identify the cause of errors and faults which may occur as a result of damage to the pump or failure of an internal component. The following table lists the error codes and describes what action to take to resolve the problem. A general fault diagnosis checklist is also provided.

For information on alarm procedures and messages, refer to the relevant *Directions For Use* (*DFU*).

If the nature of the problem is unclear, step through the **SELF TEST** routine to check that the main functions of the pump are operating correctly. The **SELF TEST** routine exercises all the sensors in the pump to verify that they are functioning accurately. See Chapter 3, 'Routine Maintenance' for details.

The **SERVICE LOG** records the ten most recent malfunction codes. To review the **SERVICE LOG** enter the access code **376**. To reset the service log errors (and battery/power on time) to zero press the **RESET** softkey.

Error Codes

Error	Failure	Action/Replace
1 GRID SPEED	Insufficient movement detected	Check for contamination or damage to the linear grid. Check flexi circuit, replace if necessary. Check grid opto in Self-Test 123.
2 GRID SPEED	Excessive motor speed detected	
3 MOTOR CONTROL	Too many motor encoders	Check mechanism is not slipping or opto flag loose. Check motor and mechanism, replace as necessary. Check connections between flexi circuit and Control PCB. Check flexible circuit, replace if faulty. Replace Control PCB.
4 MOTOR CONTROL	Too few motor encoders	
5 RAM	Failure of RAM	Check backup battery and replace if necessary. Clear RAM (611). Replace Control PCB.
6 WATCHDOG	Watchdog timer too slow during power up	Check Control PCB ribbon cable for damage, replace if necessary. Replace Control PCB.
7 WATCHDOG	Watchdog timer too fast during power up	
8 COVER DETECT	Cover detect reed switch closed when drive is disengaged.	Check cover detect reed switch operation by running Self-Test 123. Check magnet has been removed in test mode.
9 MOTOR CONTROL	Motor control	Check motor wires are connected correctly. Check flexi circuit, replace if necessary. Replace motor gearbox or Control PCB.
10 VREF	Voltage out of range	Check Control PCB ribbon cable for damage, replace if necessary. Check battery terminal connections are secure. Replace Power PCB or Control PCB as necessary
11 BEAM	Beam failure	Replace Beam bond assembly.
12 AMP	Amp failure	Replace Beam bond assembly. Replace Control PCB.
13 MOTOR OFF FAILED	Motor off should be on during power up motor control test	Check flexi circuit, replace if faulty. Replace motor gearbox. Replace Control PCB.
14 MOTOR ON FAILED	Motor on should be off during power up motor control test	
15 WATCHDOG	Watchdog failure	Check for radio frequency interference (RFI). Replace Control PCB.
16 PLUNGER STUCK	Plunger stuck at power up	Check nothing is holding the plunger in and power on. Replace flex circuit plunger optic. Replace Control PCB.
17 HARDWARE	Display fault	Replace Display Board.
18 SOFT FAULT	Software fault: CRC failure	Clear RAM (611). Replace EPROM. Replace Control PCB.

Error Codes *(continued)*

Error	Failure	Action/Replace
19 WATCHDOG	Watchdog failure	Check for RFI. Replace Control PCB.
20 HANDSWITCH	Handset fault	Check handset and handset inlet cable connections. Check handset in Self-Test 123. Replace if necessary. Replace Power PCB or Control PCB as necessary.
21 CRC	CRC failure	Replace EPROM. Replace Control PCB.
22 STACK	Stack error	Check for RFI. Replace Control PCB.
23 OPTO	Opto failure	Check optos in Self-Test 123. Check flexi circuit, replace if faulty. Replace Control PCB.
24 HARDWARE	VBAT signal out of normal limits	Replace Power Supply PCB, Control PCB as necessary.
25 HARDWARE	Video RAM fault	Re-seat/replace Display PCB and/or Control PCB.
26 SWITCH STUCK	Front panel button stuck	Power pump OFF/ON without holding any buttons. Run Self-Test 123. Check Display PCB spacer buttons. Replace Display PCB.
32 SOFTWARE FLOW CONTROL	Software flow fault	Replace Control PCB.
33 RAM	Software fault RAM	
34 SOFT FAULT	Software fault: Divide by zero	
35 MICROCONTROLLER	Software fault: Invalid instruction	
36 ADDRESS ERROR	Software fault: Address error	
37 SOFT FAULT	Software fault: NMI	
38 TRAP FUNCTION	Software fault: Trap function	

General Fault Diagnosis

	Parts to Check/Test											
Fault	**Upper** Case	**Lower** Case	Labels & Keypads	**Transmission**	**Syringe Sizing Potentiometer**	Control PCB	Power PCB	Display PCB	Battery	Mains Lead	**Fuses**	**External RFI**
Dropped or damaged	✓	✓	✓	✓	✓	✓	✓	✓				
Exposed to fluids	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
No battery power			✓			✓	✓	✓	✓		✓	
No AC mains power			✓			✓	✓	✓		✓	✓	
Delivery rates out of tolerance	✓			✓		✓						
Continuous alarm at power up						✓	✓		✓			
Incorrect display contrast/ backlight						✓		✓				
Keypad buttons stuck			✓			✓		✓				
Drive disengaged alarm				✓								
Syringe empty/NEOI alarm				✓		✓						
Reset to start-up screen during infusion						✓	✓		✓	✓		✓

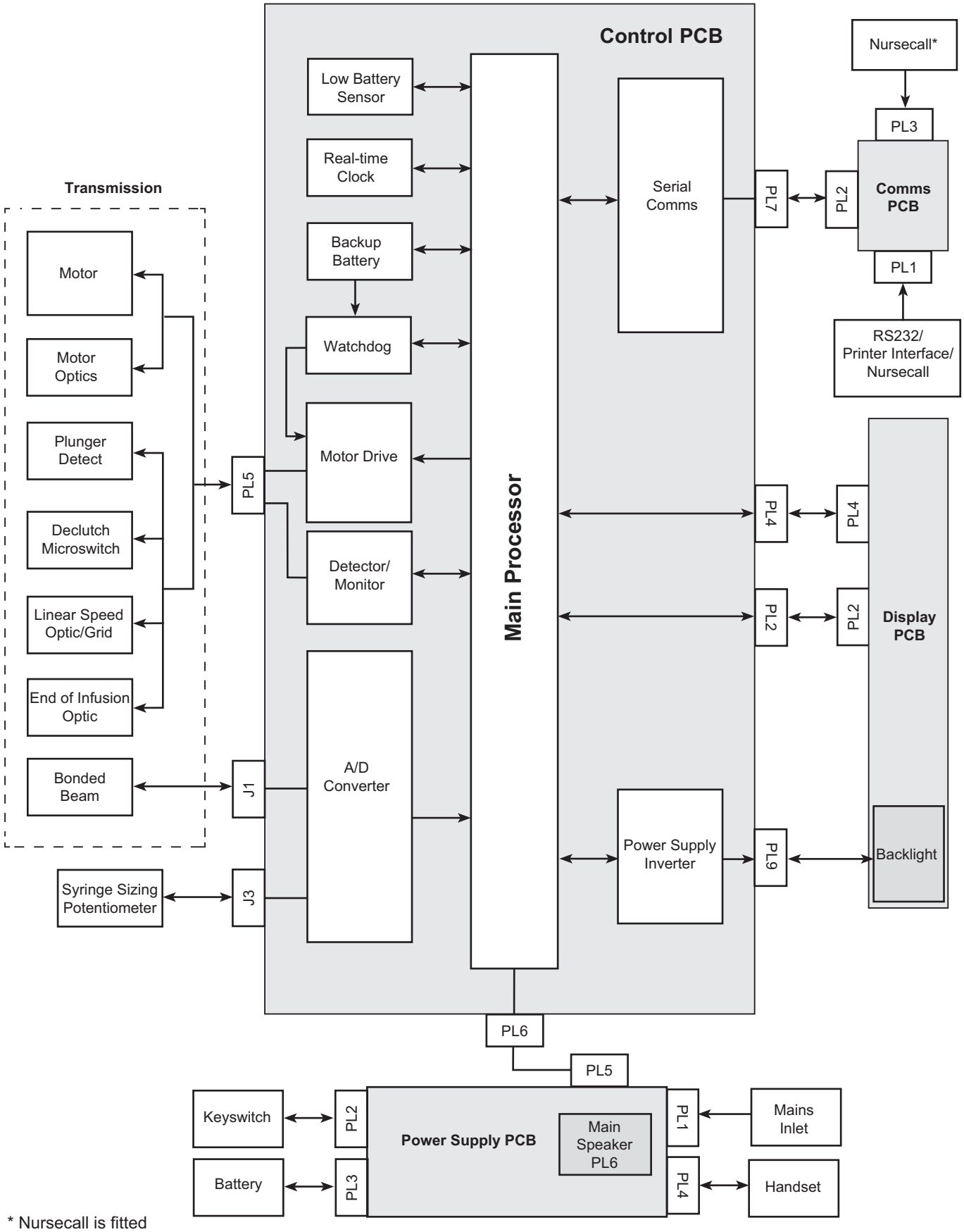
Chapter 5

Circuit Descriptions

In this chapter

Functional Module Block Diagram

IVAC® PCAM® Syringe Pump



* Nursecall is fitted separately on earlier model pumps.

Module Overview Functional Description

The IVAC® PCAM® Syringe Pump is designed to be serviced generally to major assembly level.

The circuitry within the pump is contained on four printed circuit boards (PCBs): Control PCB, Display PCB, Power Supply PCB and Communications PCB. In addition, two flexible printed circuits are utilised to hold the optical sensors and to provide the necessary interconnects to the moving parts of the pump.

Cardinal Health will make available, on request, circuit diagrams which will assist appropriately qualified technical personnel to repair those parts of the device which are designated by the manufacturer as repairable.

Control PCB

Contains the main processor module which provides the control functions for almost all aspects of the pump. It drives and monitors all other modules using the program code stored in the flash EPROM. The main processor runs the main application program.

- **Power Supply Supervisor**
  The power supply voltage is monitored by IC6 which provides an active low reset signal to the microcontroller at power up and if the regulated 5V input falls below a preset level. IC6 also switches battery backup power to the static RAM IC4 and real time clock chip IC13.
- **Real-time Clock**
  The real time clock chip, IC13, maintains time and date information.
- **Watchdog**
  The watchdog alarm will enable the audible alarm on the Power Supply PCB and disable the motor supply current.
- **Audible Alarm Drive**
  The audible alarm is located on the Power Supply PCB, the alarm signal is fed to PL6.
- **AC/DC Input**
  The AC/DC input level is a high or low signal from the Power Supply PCB. The signal from the Power Supply PCB is high at PL6 when AC is connected and low when the pump is being operated from its internal battery.
- **Motor Drive and Speed control**
  The motor speed is controlled by adjusting both the mark-space ratio of the drive signal and its repetition rate applied to the DC motor. In normal operation if the watchdog fails the power is prevented from reaching the motor.

  The motor speed control algorithm uses three feedback signals from the optical switches. The optical encoder signals are all fed via schmitt trigger inverters in IC14. The direction of the motor is monitored during operation using the optical encoder signals and linear speed sensor.
- **Linear Speed Sensor**
  The linear movement of the pump transmission is monitored using a slotted optical switch, known as the linear speed opto, coupled with a linear grid. As the optical switch moves over the slots in the linear grid, the signal from its output changes state. This signal is applied to a schmitt trigger, IC14, via PL5 and the output is then read by the microcontroller via IC9. The LED in the optical switch is switched on and off by TR9 so that the operation of the optical device can be self tested during normal operation.
- **Bonded Beam**
  The pumping pressure of the pump is detected by measuring the deflection of a beam at the end of the leadscrew on the transmission by using a full bridge strain gauge. The output from the strain gauge is fed to a 2 stage differential amplifier, IC1. The offset value of the amplifier i.e. with no pumping pressure applied, can be adjusted using potentiometer RV1, and is set during calibration.
- **End of Infusion Detect**
  The near end of infusion point is detected using a slotted optical switch which is mounted on the motor mounting plate of the transmission assembly. The signal from the optical switch changes state, thus detecting a near end of infusion, when a flag which is mounted on the transmission carriage passes through the slot in the optical switch. The change of state position is independent of the actual syringe near end of infusion point. The change of state initiates a countdown to the near end of infusion alarm point in software. The countdown depends upon the syringe type and rate of infusion. This signal is applied to a schmitt trigger then read via IC9.
- **Plunger Detect**
  The syringe plunger button position is detected using a slotted optical switch. The signal from the optical switch changes state when the syringe plunger is located correctly; this signal is fed to IC9.
- **Transmission Disengaged Detect**
  A microswitch is mounted on the transmission carriage to detect when the transmission drive has been disengaged. The signal from the microswitch changes state when the declutch levers are activated. This signal is fed via IC16 to the microcontroller.
- **Visual Indicators**
  The start and stop LEDs are located on the Display PCB but are driven through IC15. The AC power LED is driven directly from the Power Supply PCB via connections on the Control PCB.

Control PCB *(continued)*

- **Keypad**

Module Overview Functional Description *(continued)*

The keypad is located on the Display PCB but is polled from the Control PCB by sequentially taking the keypad columns low and testing the state of the keypad rows to determine which button is activated. The keypad columns are driven through IC15, via the data bus and the keypad rows are read directly into the microcontroller via input pins.

- **LCD Display Drive**
  The LCD display is located on the Display PCB; data is passed using the data bus to a graphics controller located on the Display PCB.
- **Syringe Size Measurement**
  A linear potentiometer mounted in the upper case detects the movement of the syringe clamp shaft. The linear potentiometer is configured as a potential divider and produces a signal relative to the syringe diameter. The signal from the potentiometer is fed into the one of the ADC inputs of the microcontroller.
- **Serial Communications**
  The serial interface signals, respiration alarm input and nurse call alarm output are fed to PL7. Pull up resistors are fitted to the RX inputs so that if a Communications PCB is not fitted the inputs to the microcontroller are held high.
- **Backlight Power Supply Inverter**

  Warning: This circuit has high output voltage. the pump must only be serviced by qualified personnel using the recommended equipment.

  The Display PCB backlight is supplied by a switched mode inverter power supply on the Control PCB. The main controller for the supply is IC8 which generates a pulse output on pin 7. The supply operates to control the lamp current at about 5mA and operates over the full mains unregulated supply and internal battery voltages, fed via MVCC.

Power Supply PCB

The Power Supply PCB is located in the lower case. All connections between the Power Supply PCB and the Control PCB are made via PL5.

- **Mains Input (AC Power)**
  The pump can be operated either from 110/120V or 220/240V AC power supplies depending on the configuration of the links on the Power Supply PCB. (LK1 & LK3 for 110/120V, or LK2 for 220/240V; these links are made using insulated wire on the non-component side of the PCB). AC power is applied to the pump using a standard IEC connector from which an internal connection takes the AC power to the power supply PCB via PL1. The live connection is protected by fuse, FS1.
- **Battery Charging**
  The internal lead acid battery is automatically recharged whenever the pump is connected to the AC power supply. The battery is protected against short circuit by a fuse FS2, rated at 2A. Fuse FS3 provides a separate ground connection for the audible alarm such that if fuse FS2 were to blow when the pump is running on the internal battery, a continuous alarm would sound.
- **Audible Alarm**
  The audible alarm is located on the power supply PCB and can be enabled either by the audible alarm drive, or the watchdog alarm signal.
- **Handset**
  The handset connector PL4 provides power to switch on the handset LEDs and also feeds a voltage from the handset back to the Control PCB. See 'General Options', HANDSET MODE in Chapter 2 for further details.
- **Keyswitch**
  The keyswitch has three positions. In the OFF position the power to the pump is isolated leaving only the battery charger operational on mains. In the SET and RUN positions power is supplied via PL2 so that the microcontroller and its software can determine the switch position.

Display PCB

The Display PCB is located in the upper case. All connections between the Display PCB and the Control PCB are via PL2 and PL4. For the purposes of maintenance and repair, the Display PCB is supplied as a complete module, however, the Backlight can be replaced separately.

- **Keypad**
  The keypad is made up of 10 individual mechanical switches and is arranged in an X-Y matrix. The keypad is polled from the Control PCB.
- **Backlight**
  The LCD panel is backlit by a CCFL lamp which is mounted along one edge of the Display PCB. The backlight power supply is driven from the Control PCB.

Module Overview Functional Description *(continued)*

Flexible Circuits

Two flexible circuits are used to connect the motor, opto switches and declutch microswitch on the transmission to the Control PCB.

- **Motor Optical Encoders**
  Two slotted optical switches are mounted on the back of the motor/gearbox assembly to detect the speed and direction of rotation. The optical switches are activated by a flag mounted on the rear output shaft of the motor.
- **End of Infusion Optical Switch**
  A slotted optical switch is mounted on the transmission motor plate to detect the near end of infusion point. It is activated by a flag which is mounted on the transmission carriage.
- **Linear Speed Optical Switch**
  A slotted optical switch is mounted on the transmission carriage and is used in conjunction with a slotted grid to monitor the linear travel of the pump.
- **Declutch Microswitch**
  A micro switch is mounted on the transmission carriage to detect when the transmission drive has been disengaged.
- **Plunger Detect Optical Switch**
  A slotted optical switch is mounted inside the plunger holder. It detects when a syringe plunger is correctly located in the plunger holder.

Communications PCB

The Communications PCB is located in the lower case. The RS232/Printer/Nursecall/Alarm Input interfaces are incorporated on the PCB.

- **RS232 interface**
  An isolated circuit forms the communication RS232 interface, using IC3 and IC4.
- **Printer/Smart Card interface**
  This interface allows data to be sent to a printer (or a smart card) from the Control PCB microcontroller.
- **Nursecall interface**
  The nurse call interface allows the pump to be monitored remotely and/or controlled via a suitable central monitoring or computer system.

  Note: On earlier pump models, the isolated Nursecall circuit PL3 is used to allow connection to a conventional nurse call system. A single relay contact is open during normal operation of the pump. If the pump alarms or the power is switched off the relay contacts close, activating the nurse call circuit.
- **Alarm Input interface**
  The alarm input allows the pump infusion to be stopped and an alarm to occur if the input is set to active. A common use of this interface is to connect the pump to a respiration monitor. If ALM IN input, pin 1 is pulled low by connection to pin 5 of the interface connector PL1, a current is established in the opto, OP7. The opto output then switches and can be monitored by the Control PCB microcontroller.

Chapter 6

Spare Parts Replacement Procedures

In this chapter

Introduction

- **Ensure the pump is disconnected from the AC power supply and switched off before attempting to service the pump**
- **The pump contains static-sensitive components. Observe strict ESD precautions at all times**
- **Always protect the plunger holder and syringe clamp when the pump is upside down. For regular servicing, the use of the case support cradle, part number 5000JG00001, is recommended**
- **Ensure that no undue force is applied to the plunger holder and the leadscrew, when the pump is placed upside down to remove the six case retaining screws on the base**
- **Batteries should be disposed of as outlined by the local country regulations: do not send back to the manufacturer**
- **Fastener torque settings are outlined in the 'Refitting notes' sections of this chapter**
- **Only use Cardinal Health recommended spare parts**
- **Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP), see Chapter 3, 'Routine Maintenance'**

Spare Parts: Throughout this chapter, spare part items denoted as H.1, H.2 etc indicate that these parts are included in a higher level kit and are also available separately.

Torque Guide

The torque levels established during the manufacturing process are outlined in the 'Refitting Notes' sections of this chapter. Torque levels selected apply throughout product life for the IVAC® PCAM® Syringe Pumps.

Use the information as a guide to the 'do not exceed' torque levels when servicing the pump. When servicing, it is recommended that torque is applied gradually until the component is secure. In any process do not exceed the stated levels.

If a torque driver is available for servicing this will help control the applied torque; otherwise, be aware that excess force may cause the component to fail.

Where a torque level is not stated in the 'Refitting Notes' sections of this chapter then fixing should be hand-tight.

- ◆ Always use the correct torque level when performing an assembly stage.
- ◆ Take care with the torque applied when re-assembling parts.
- ◆ The head patterns of the fasteners are of the following types:
  - Pozi Number 1 (smaller X head)
  - Pozi Number 2 (larger X head)
  - M3 (Hex head with 5.5mm across flats (AF) drivers)
- ◆ Always select the correct tool and bit pattern for the fastener.

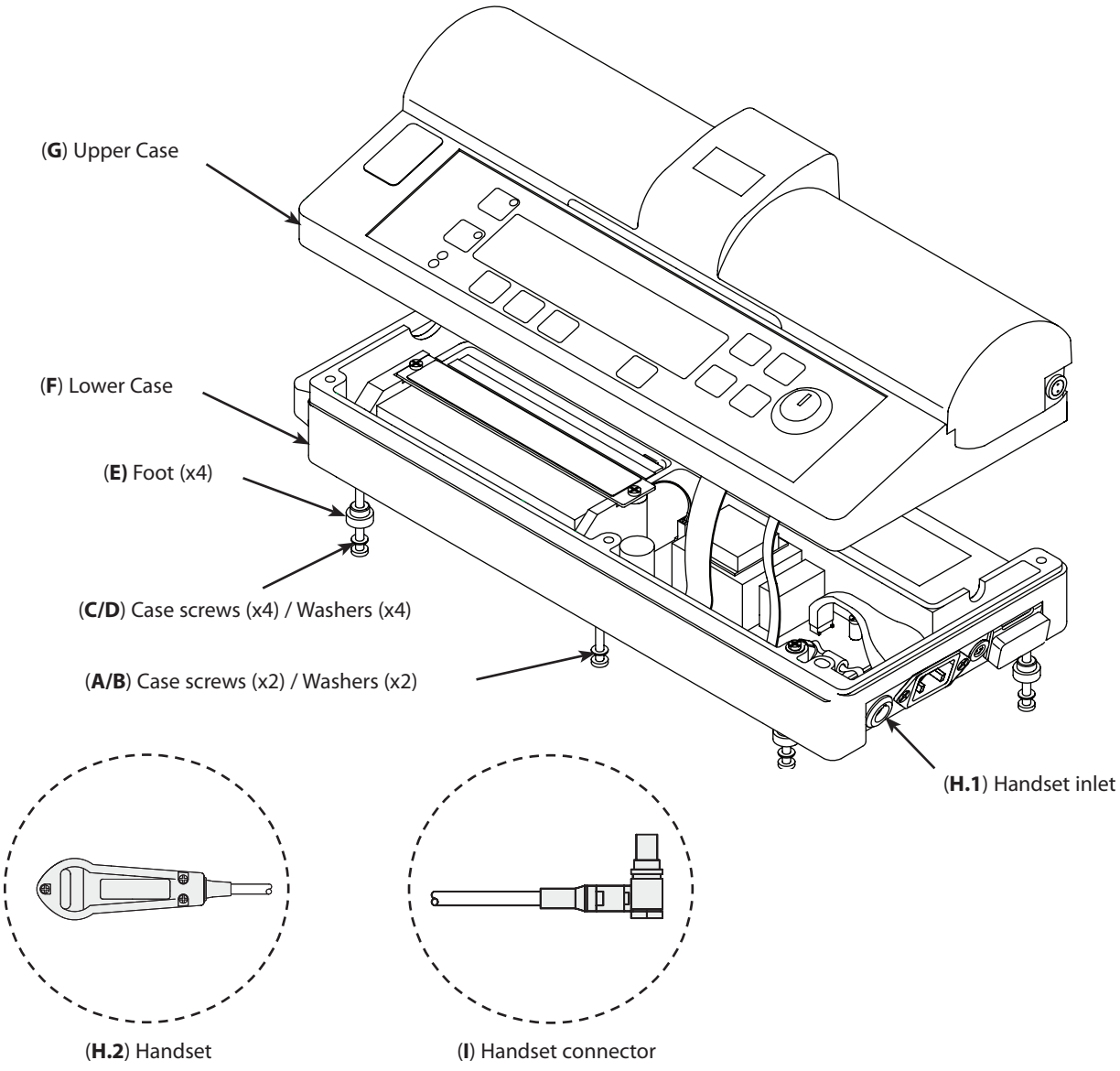
Accessing the Pump

Replacement Procedure

1. Remove the handset assembly.
2. Remove the six case retaining screws and washers located on the base of the pump.
3. Carefully separate the upper and lower case halves and disconnect cables.
4. Reassemble in reverse order.

Refitting note:

When closing the case halves, ensure the longer ribbon cable (5000EL00049) is firmly adhered to the top of the PSU transformer and folded correctly (see 'Power Supply PCB' illustration) and the shorter ribbon cable (1000EL00135) is stowed in front of the PSU transformer. Also keep the narrow 4-pin keyswitch cable away from board components, it can be tucked around the front of the Control PCB speaker.



Upper Case and Lower Case

- **Fit replacement upper case (5000SP00017) and lower case (5000SP00018) if the pump build issue is 46 or above**
- **If the pump build is *below* issue 46, use spare part kit 5000SP00029 which includes replacement upper case (5000SP00017) and lower case (5000SP00018) plus additional replacements: RS232 gasket/PCB, base plate, Power Supply PCB and moulded foot**

Accessing the Pump *(continued)*

Spare Parts

Item	Description	Part Number
A	SCREW M3x6 CSK HD POSI 1 Z+BLACK	0000ME00222
B	WASHER M4 WAVEY SST	0000ME00045
C	SCREW M4 X 50 PAN POSI	0000ME00302
D	WASHER M4 PLAIN ZINC PLATED	0000ME00310
E	SPARE UPGRADE MOULDED FOOT	1000SP01066
F	SPARE CASE LOWER P5000	5000SP00018
G	SPARE CASE UPPER P5000	5000SP00017
F & G	SPARE UPGRADE P5000	5000SP00029
H	SPARE UPGRADE HANDSET P5000 'HW'	5000SP00030
H.1	ASSY HANDSET MK2 INLET	5000SP00027
H.2	ASSY HANDSET P5000	5000SP00026
I	SPARE UPGRADE HANDSET CONNECTOR PCAM	5000SP00051

Lower Case Assembly

Replacing the lower case

1. To replace a lower case, it will be necessary to fully strip down the old case and insert all the components into the new lower case. This task requires a good knowledge of the pump, so be certain that you are fully conversant with all the procedures in this chapter before undertaking this replacement.
2. To strip down each lower case sub assembly, follow the instructions in the relevant section of this chapter. These sections are:
   - Accessing the Pump
   - Battery
   - Power Supply PSB, Alarm, Mains Inlet
   - Handset Inlet Assembly
   - RS232 Connector, Nursecall Connector, Comms PCB
   - Pole Clamp Assembly
   - Labels
3. To reassemble the components into the new lower case, simply reverse the order of disassembly.

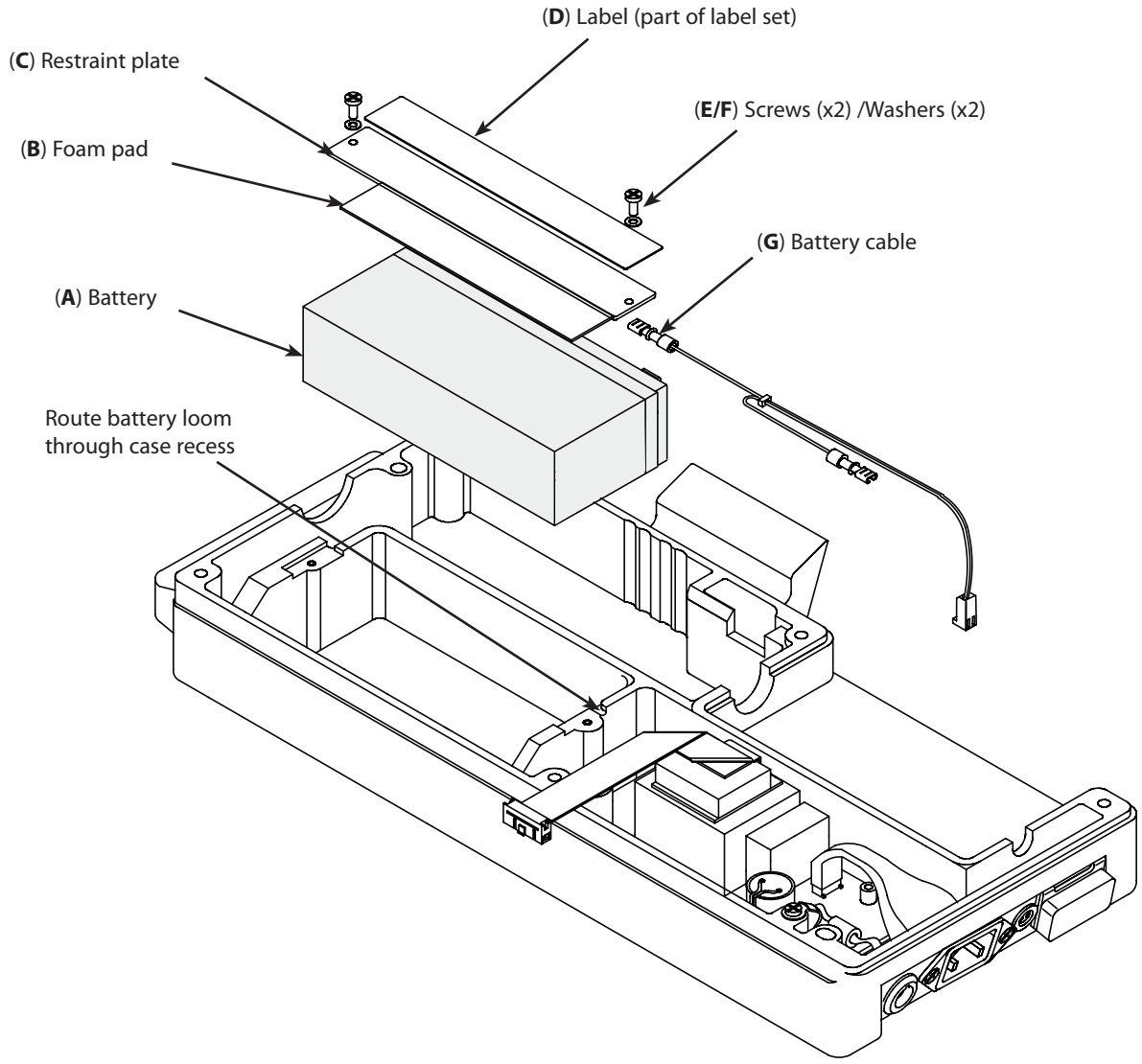
Battery

Replacement Procedure

1. Disconnect the battery cable from the Power Supply PCB.
2. Remove the two screws which secure the battery retaining plate.
3. Lift out the battery and retaining plate then disconnect the crimp terminals from the battery.
4. Detach the retaining plate from the battery.
5. Reassemble in reverse order.

Refitting note:

Route battery loom under terminals then through the casing recess (see illustration below).



Spare Parts

Item	Description	Part Number
A	BATTERY 6V SLA RECHARGE	0000EL00004
B	FOAM PAD BATTERY	1000ME01064
C	PLATE BATTERY RESTRAINT PUNCHED	1000ME01123
D	LABEL SET P5000	5000LB00020
E	SCREW M3X6 PAN HD POSI ZP+P	0000ME00221
F	WASHER M3 WAVEY SST	0000ME00015
G	ASSY CABLE BATTERY	1000SP00009

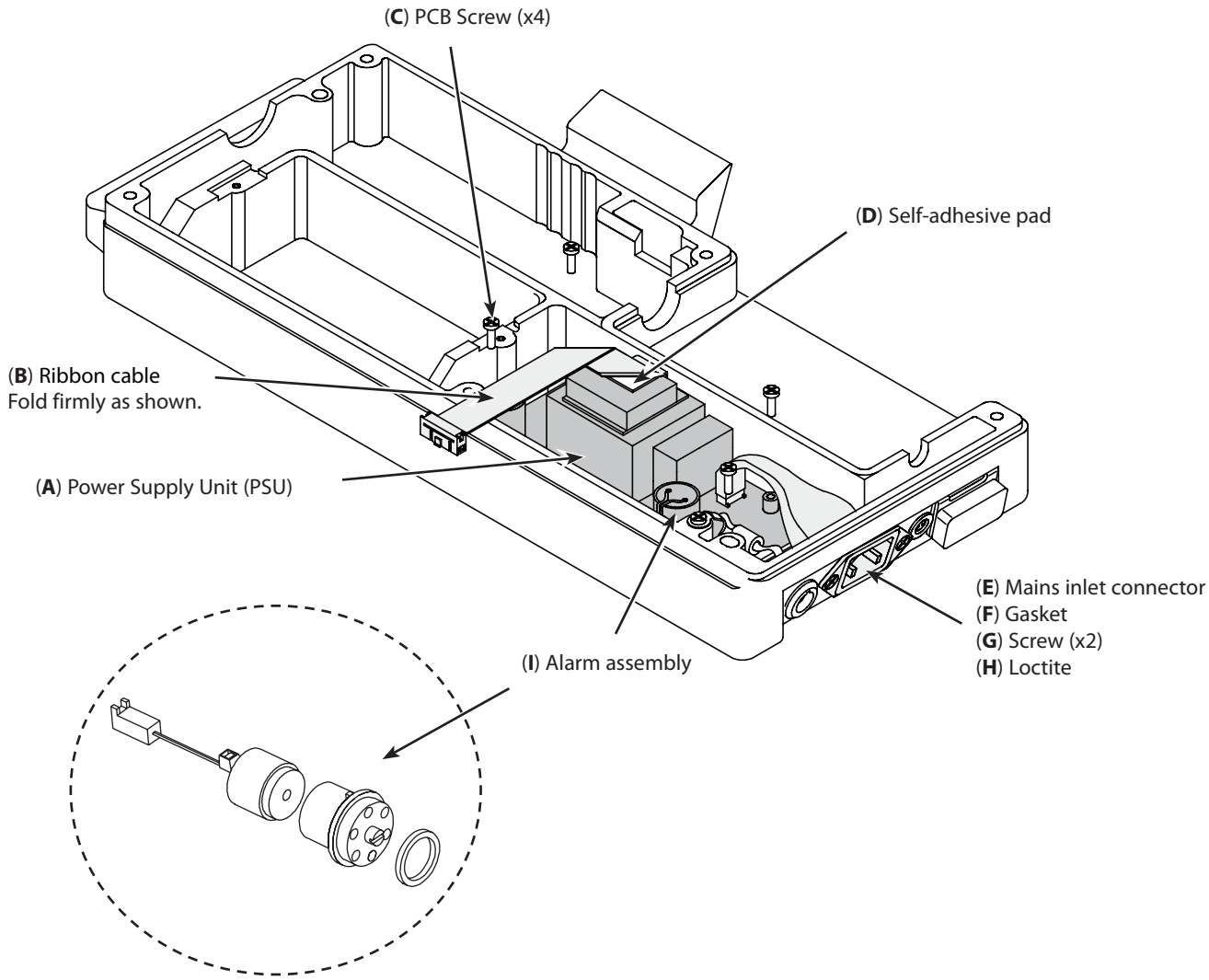
Power Supply PCB, Alarm, Mains Inlet

Replacement Procedure

1. Disconnect the 8-pin grey ribbon cable, the mains inlet connector, the handset connector and the battery connector from the Power Supply PCB.
2. Remove the two screws securing the mains inlet to the lower case. Slide out the mains inlet assembly and gasket.
3. Remove the four Power Supply PCB fixing screws and remove the PCB.
4. Remove the alarm speaker and seal ring from the Power Supply PCB noting the recess hole in the base of the lower case for siting the speaker.
5. Reassemble in reverse order.

Refitting note:

If the self-adhesive pad (item D) is not present, fit the pad to the top of the transformer then fold the ribbon cable firmly as shown below.



Power Supply PCB, Alarm, Mains Inlet *(continued)*

Power Supply PCB

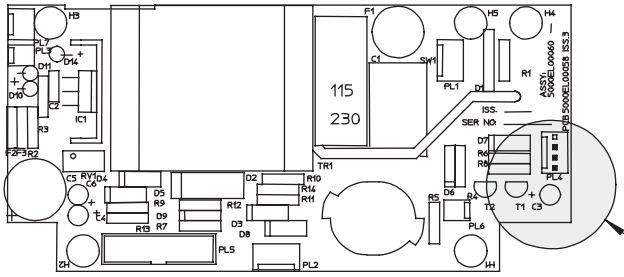
- **Replace alarm speaker with sounder mode kit (1000SP00560) if pump is fitted with Power Supply PCB 5000EL00060, issue 23 and below and exhibits poor sound quality, such as an unstable or two-tone performance**

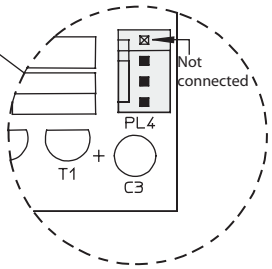
- **Replace molex header on pumps fitted with Power Supply PCB 5000EL00038/5000SP00030, pumps with serial numbers 5001-00083 to 5001-01341, build issues 46 and below. See procedure below**

Replacing the molex header

Procedure:

1. Pull the existing 4-way molex header off the board, leaving the pins. Crop pin 1 to within 1mm of the board.





2. Remove the pins from the supplied 3-way molex header. Fit the bare header over the pins. Ensure that the header is pushed down onto the board and that the pins are not bent during the fitting of the header. The connector must be fitted in the same orientation as the existing connector. Pin 1 is not connected.

Spare Parts

Item	Description	Part Number
A	SPARE POWER BOARD 230V P5	5000SP00043
B	ASSY CABLE 16 WAY RIBBON	5000EL00049
C	SCREW M3x12 POZI HD Z+C	0000ME00189
D	PAD SELF ADHESIVE DOUBLE SIDED 12X12mm	0000ME00423
E	ASSY INLET MAINS CONNECTOR	1000SP01001
F	GASKET MAINS INLET V4	1000ME01074
G	SCREW M3X8 CSK HD POSI SS	0000ME00268
H	ADHESIVE LOCTITE 243	0000ME00672
I	PCAM SOUNDER MODIFICATION	1000SP00560
*	LINK FUSE 2A PICOFUSE	0000EL00284
*	FUSE 63mA 20mm A/S ANTI-SURGE	0000EL00287

* item not shown

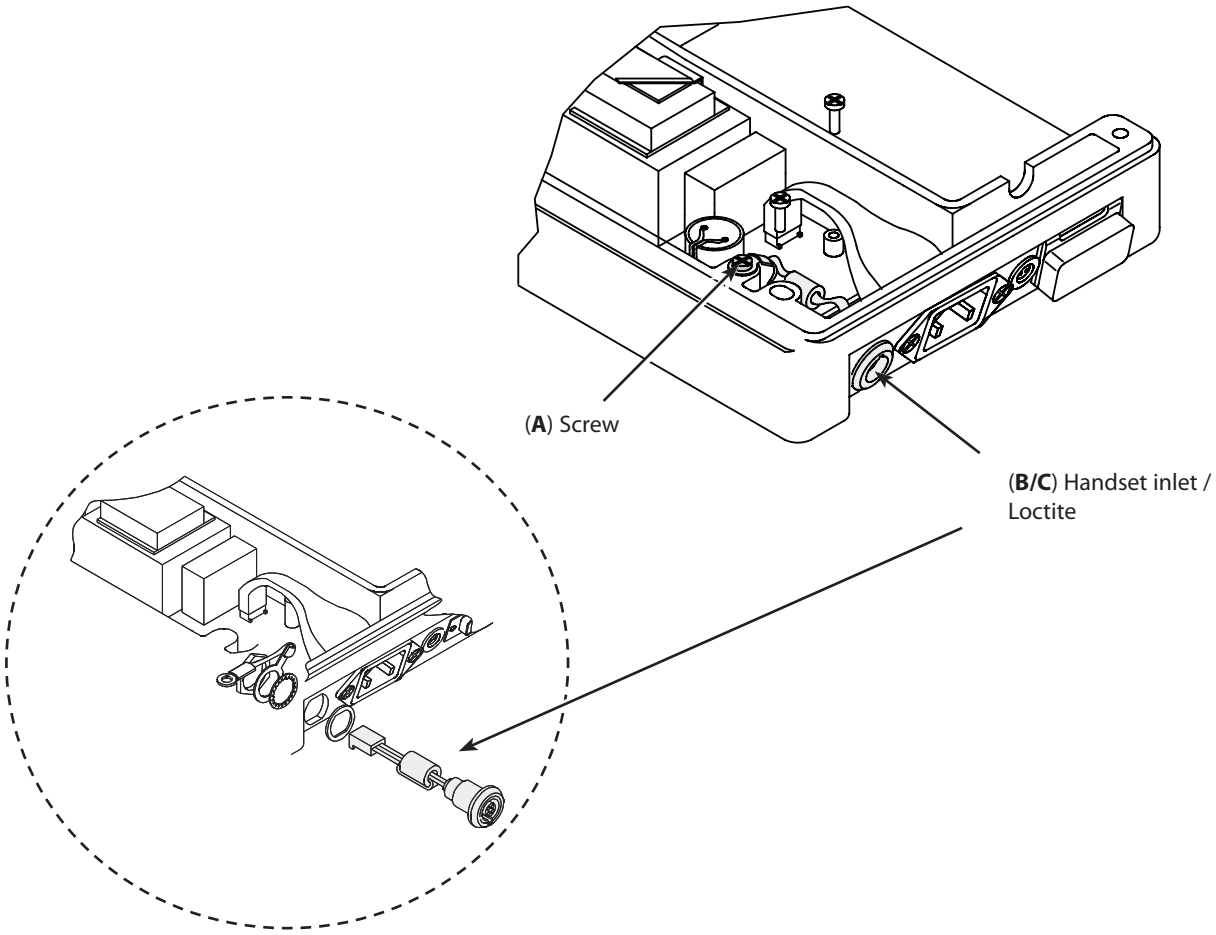
Handset Inlet Assembly

Replacement Procedure

1. Disconnect the handset inlet connector from the Power Supply PCB.
2. Remove the screw (**A)** securing the handset earth braid.
3. Remove the lock nut from the back of the handset inlet assembly and remove the earth braid and shakeproof washer.
4. Remove the handset inlet assembly from the lower case.
5. Reassemble in reverse order.

Refitting notes:

1) Apply loctite (243) to the lock nut before assembly.
2) When securing the handset inlet assembly lock nut, ensure the red dot (on the outside seal) faces to the right.



- **Fit replacement handset seal (0000ME00219) if the pump serial number is within the range 5001-00094 to 5001-1006**
- **Fit replacement handset inlet assembly (5000SP00030) if the pump serial number is within the range 5001-01043 to 5001-01341, build issue 46 or below, and where a shakeproof washer is not fitted to the handset assembly**

Spare Parts

Item	Description	Part Number
A	SCREW No4 X 1/4" PAN HD	0000ME00011
B	ASSY HANDSET MK2 INLET	5000SP00027
B	SPARE UPGRADE HANDSET P5000 'HW'	5000SP00030
C	ADHESIVE LOCTITE 243	0000ME00672

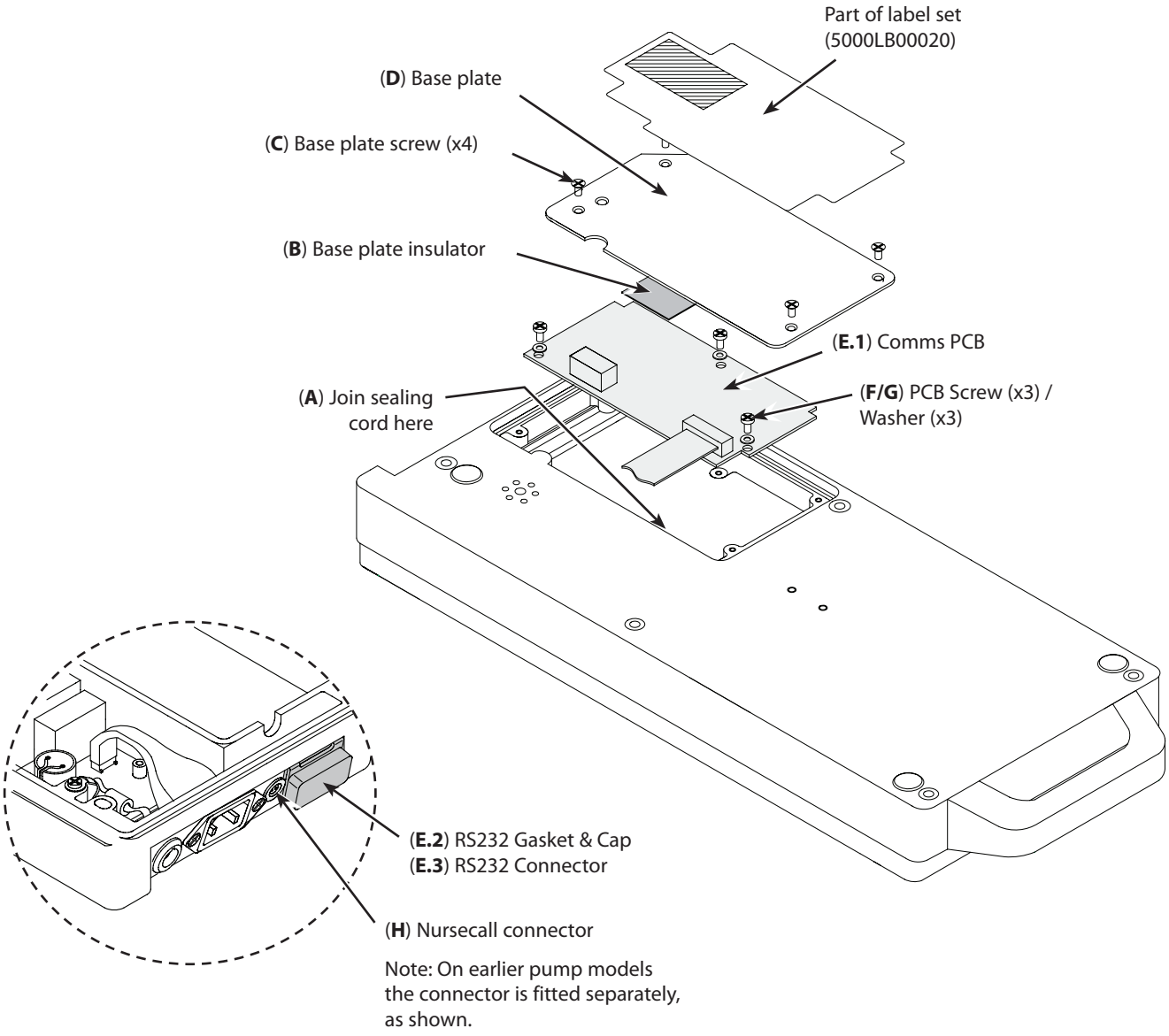
RS232 Connector, Nursecall Connector, Comms PCB

Replacement Procedure

1. Remove the four screws securing the base plate to the underside of the lower case. Hinge the base plate open and remove it.
2. Disconnect the RS232 connector and the nursecall connector (if fitted) from the Communications PCB.
3. Remove the two screws securing the RS232 connector to the lower case. Slide out the connector assembly and gasket, carefully pulling the RS232 cable ends through the slot in the case wall.
4. Remove the nut securing the nursecall connector and slide out the connector assembly (where nursecall connector is fitted separately).
5. Remove the three screws and washers securing the Communications PCB. Remove the Communications PCB, pulling the ribbon cable through the slot in the case wall.
6. Remove the silicone sealing cord from the groove in the lower case. Note the position of the joint (see the illustration below).
7. Reassemble in reverse order.

Refitting note:

1) If inverted nursecall is required, fit the 2-way nursecall connector into the PCB connector marked "NIRA ONLY". For standard nursecall, fit the 2-way nursecall connector into the unmarked PCB connector.
2) When securing the nursecall connector lock nut, ensure the red dot (on the assembly outside the case) faces downwards.
3) When refitting the RS232 connector (item **H**) to the lower case, apply torque level of 25cNM to the two securing screws.



RS232 Connector, Nursecall Connector, Comms PCB

Base Plate:

- **Fit insulator (1000LB00016) if the pump serial number is within the range 5001-00001 to 5001-01057**
- **Fit self-adhesive foot (0000ME00026) to the base plate if the pump serial number is within the range 5001-00094 to 5001-01006**

Spare Parts

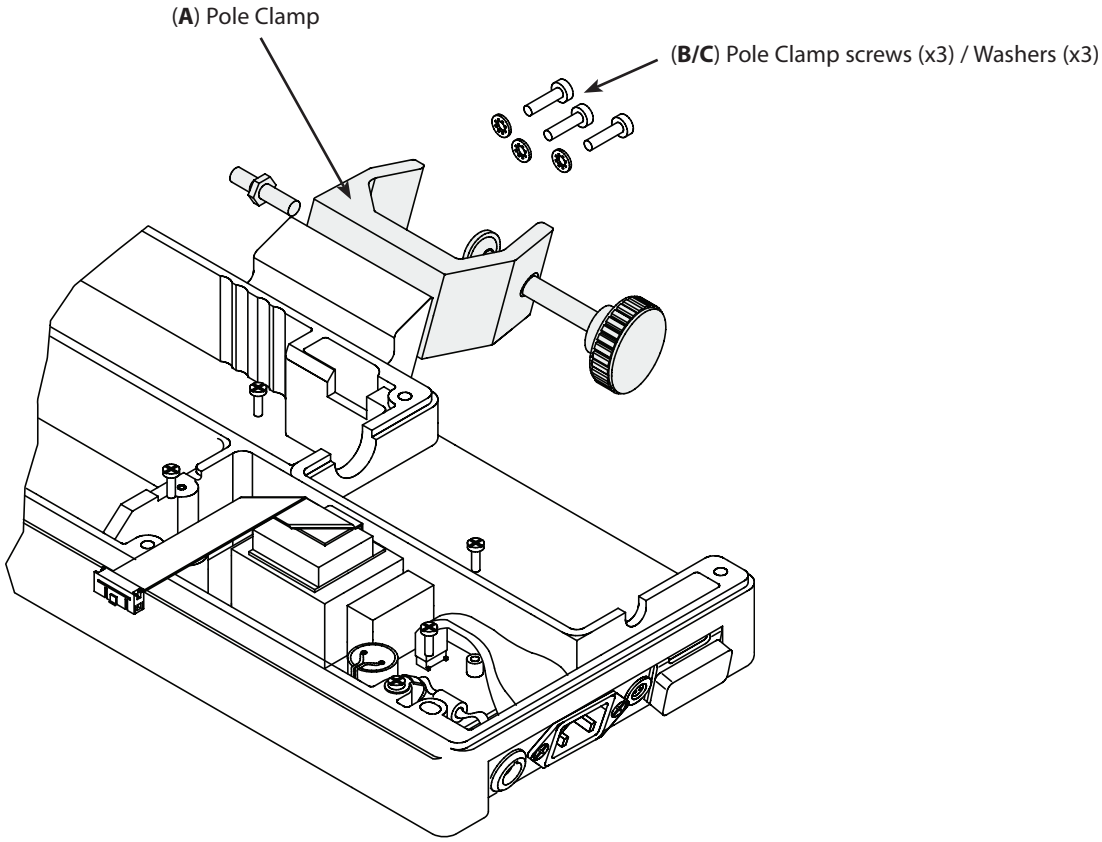
Item	Description	Part Number
A	CORD SEALING SILICONE ID 0.95	1000ME01087
B	LABEL BASE PANEL 30x30	1000LB00016
C	SCREW M3x8 CSK HD POSI SS	0000ME00268
D	PLATE BASE P SERIES	6000ME00026
E	OPTION RS232 N/C P5000	5001FAOPT01
E.1	ASSY PCB RS232/NC P5000	5000EL00072
E.2	GASKET RS232 MOULDED & CAP A4	1000ME01106
E.3	ASSY CONN RS232/NURSECALL	5000SP00039
E	SPARE FLUID SEALING UPGRADE KIT	1000SP01048
F	SCREW M3x6 PAN HD POSI ZP+P	0000ME00221
G	WASHER M4 PLAIN ZINC PLATED	0000ME00310
H	ASSY NURSECALL CONN V4	1000SP01025
*	FOOT SELF ADHESIVE V4	0000ME00026

* item not shown

Pole Clamp Assembly

Replacement Procedure

1. Remove the three pole clamp screws and washers.
2. Remove pole clamp from lower case.
3. Reassemble in reverse order.



Spare Parts

Item	Description	Part Number
A	SPARE POLE CLAMP 40MM	1000SP01015
B	SCREW	0000ME00227
C	WASHER M4 SHAKEPROOF	0000ME00286

Upper Case Assembly

Replacing the upper case

1. To replace an upper case, it will be necessary to fully strip down the old case and insert all the components into the new upper case. This task requires a good knowledge of the pump, so be certain that you are fully conversant with all the procedures in this chapter before undertaking this replacement.
2. To strip down each upper case sub assembly, follow the instructions in the relevant section of this chapter. These sections are:
   - Accessing the Pump
   - Control PCB, Display PCB
   - Transmission Assembly Removal
   - Transmission Assembly Breakdown
   - Syringe Size Pot, Syringe Clamp
   - Cover Lock Assembly, Case Sealing Cord
   - Keyswitch Assembly
   - Window Display, Front Panel Label
   - Cover, Spring Mechanism
   - Labels
3. To reassemble the components into the new upper case, simply reverse the order of disassembly.

Control PCB, Display PCB

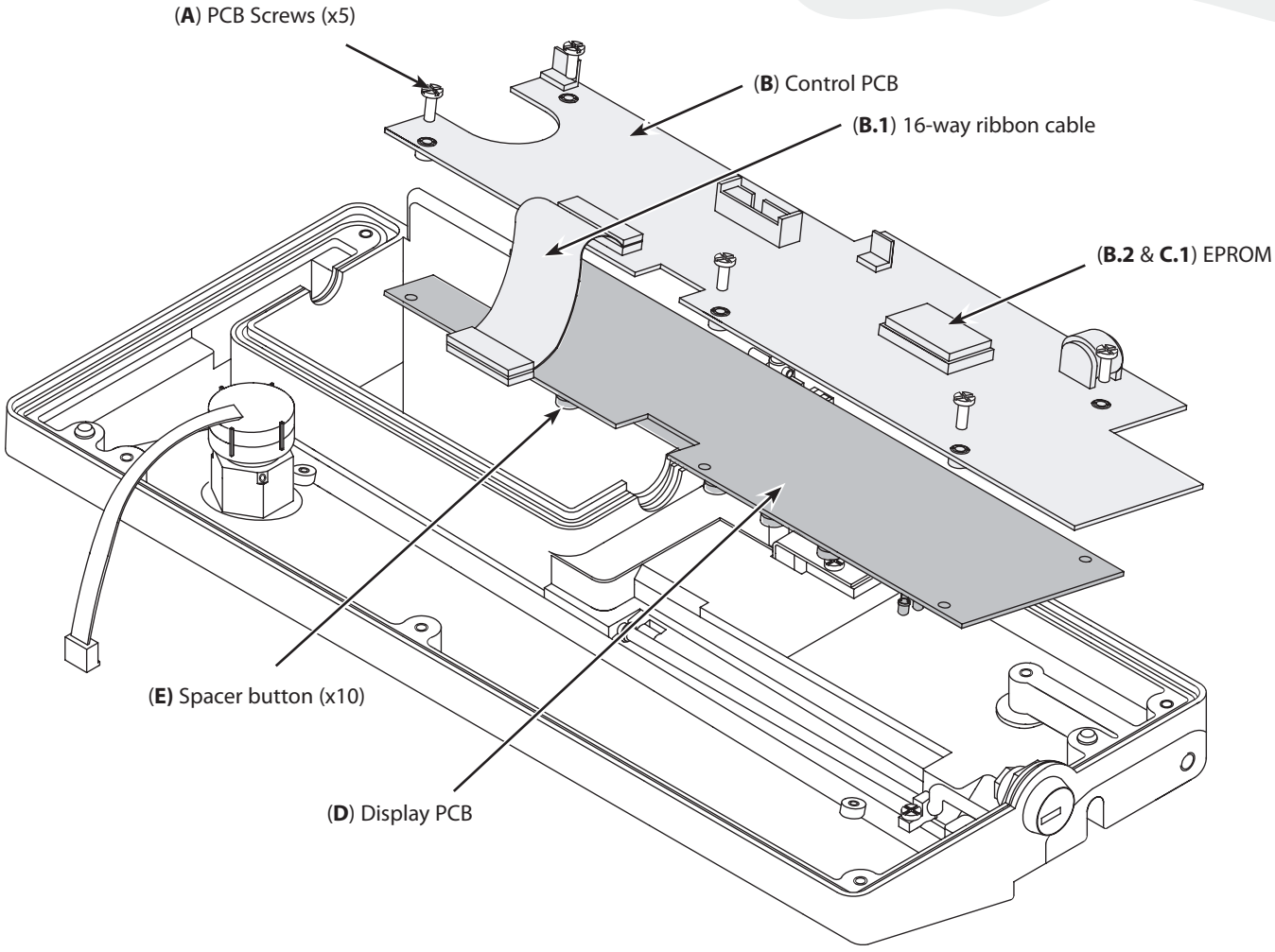
Replacement Procedure

1. Disconnect the cables from the Control PCB.
2. Remove the five PCB fixing screws and washers and withdraw the Control PCB and Display PCB together.
3. Disconnect the backlight connector and pull the PCBs apart.
4. Carefully unclip (plastic) buttons, or remove (rubber) buttons from the Display PCB switches as required.
5. Reassemble in reverse order.

Refitting notes:

1) When refitting the rubber spacer buttons, carefully push-fit each button centrally over the switches.
2) When reconnecting the PCBs, ensure the backlight connector cable is tucked around the pillar between the PCB boards.

The transmission is not shown here for clarity—it is not necessary to remove the transmission assembly in order to remove/ refit the Control PCB and the Display PCB.



Control PCB, Display PCB *(continued)*

Recommended when serviced
Replace Control PCB 0000EL00055 with 0000EL00065 (5000SP00041).

Display PCB
- **Fit clip-on rubber spacer buttons (5000ME00108) if the pump has a poor button tactile response**

Spare Parts

Item	Description	Part Number
A	SCREW M3x12 POZI HD Z+C	0000ME00189
B	SPARE CONTROL BOARD P5	5000SP00041
B	SPARE UPGRADE CONTROL BOARD	5000SP00019
B.1	ASSY CABLE 16 WAY RIBBON	1000EL00135
B.2/C.1	EPROM PROGRAM P5000	1000EL00602
B.3*	FLAT WASHER NYLON M3 TO ISO 7089	0000ME00044
C	SPARE UPGRADE S/W P5 GB/DE/FR	5000SP00049
C	SPARE UPGRADE S/WARE KIT NL	5000SP00053
C	SPARE UPGRADE S/WARE KIT IT	5000SP00055
C	SPARE UPGRADE S/WARE KIT SE	5000SP00056
D	SPARE DISPLAY BOARD P5	5000SP00042
E	SPACER BUTTON F/P CLIPON	5000ME00072
*	BATTERY NiCd 2.4V 40mAH	0000EL00208

* item not shown

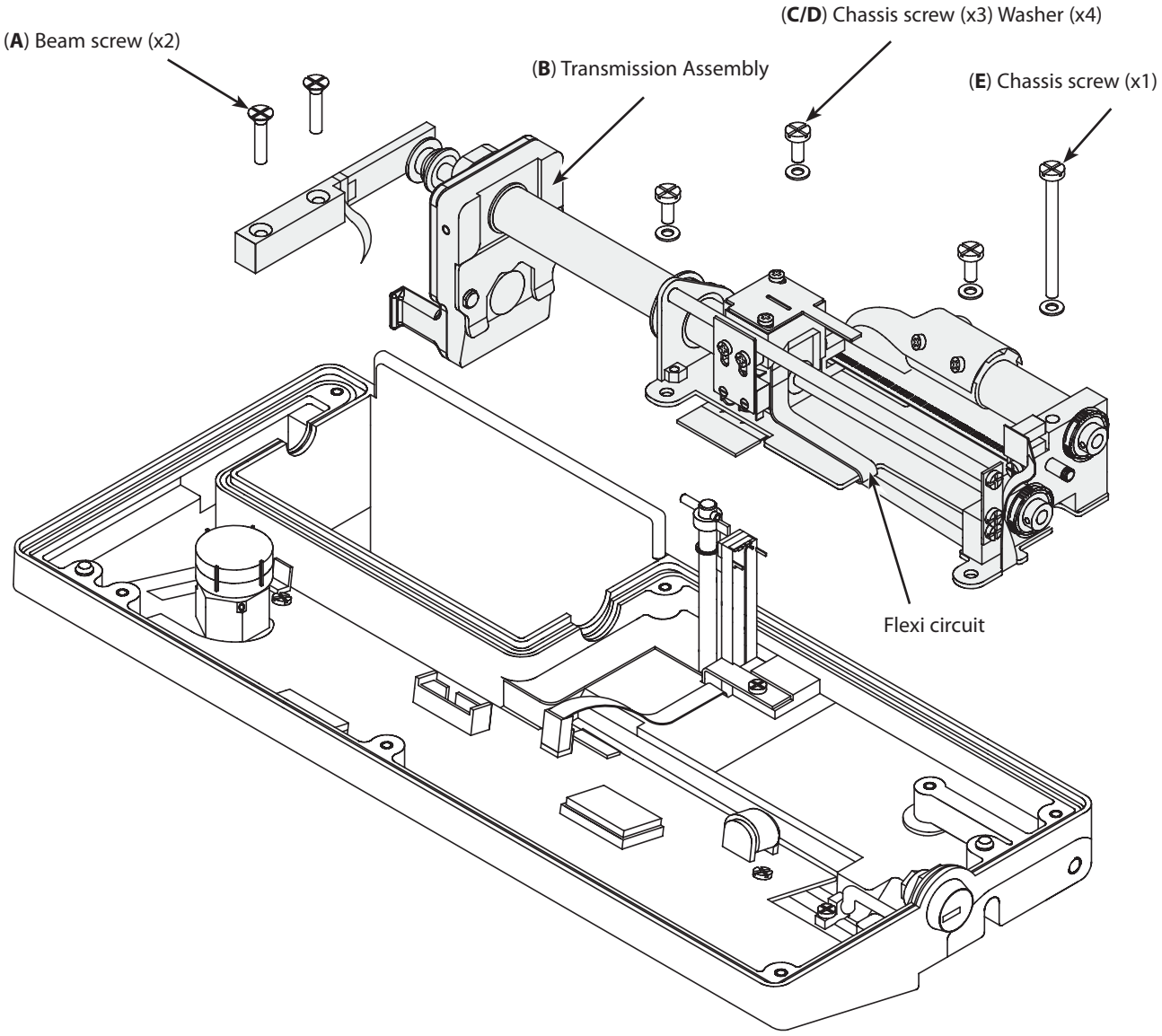
Transmission Assembly Removal

Replacement Procedure

1. Remove the four chassis screws and washers and two beam screws which secure the transmission assembly.
2. Disconnect cables and remove the transmission assembly from the upper case.
3. Reassemble in reverse order.

Refitting notes:

1) Apply torque level of 2.0NM when securing the two beam screws (item **A**).
2) Apply torque level of 1.0NM when securing the four chassis screws (items **C** and **E**).



When refitting the transmission assembly into the upper case, ensure that the flexi circuit is adjusted so the flex does not catch or click when mechanism is declutched or moved manually.

Spare Parts

Item	Description	Part Number
A	SCREW M4x20 CSK HD POSI SS	0000ME00255
B	SPARE TRANSMISSION P1/2/3 V4	1000SP01053
C	SCREW M4x8 PAN HD POSI	0000ME00246
D	WASHER M4 WAVEY SST	0000ME00045
E	SCREW M4x40 PAN HD POSI 2 ZP+P	0000ME00225

Transmission Assembly Breakdown

Bonded Beam, Leadscrew

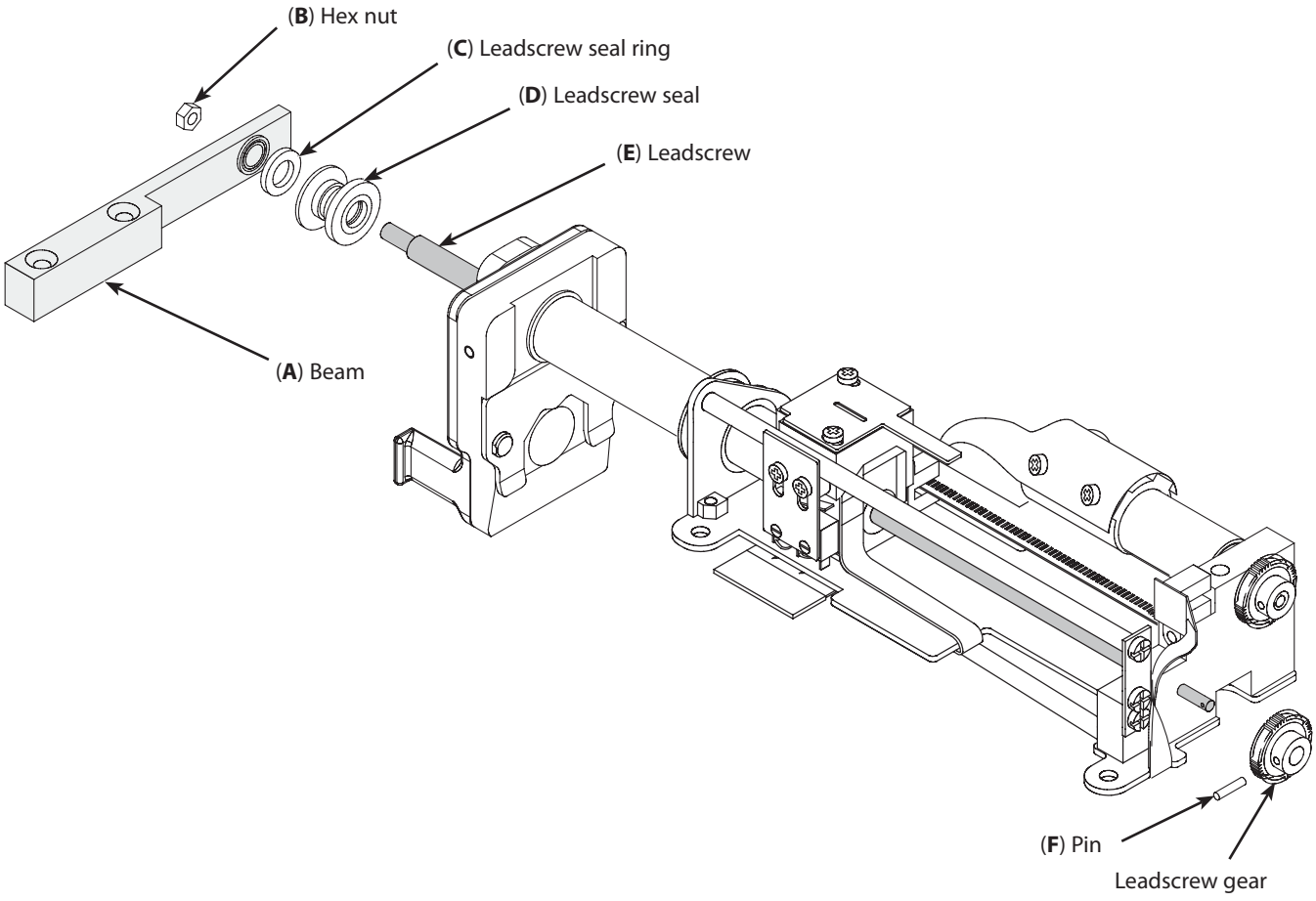
Replacement Procedure

1. Remove the nut securing the bonded beam.
2. Remove the pin securing the leadscrew gear. Declutch mechanism and pull out leadscrew.
3. Reassemble in reverse order.

Refitting note:

When refitting the bonded beam to the transmission shaft, apply torque level of 25cNM to the securing nut (item **B**).

Item C (seal ring) is fitted *over* item D.



Spare Parts

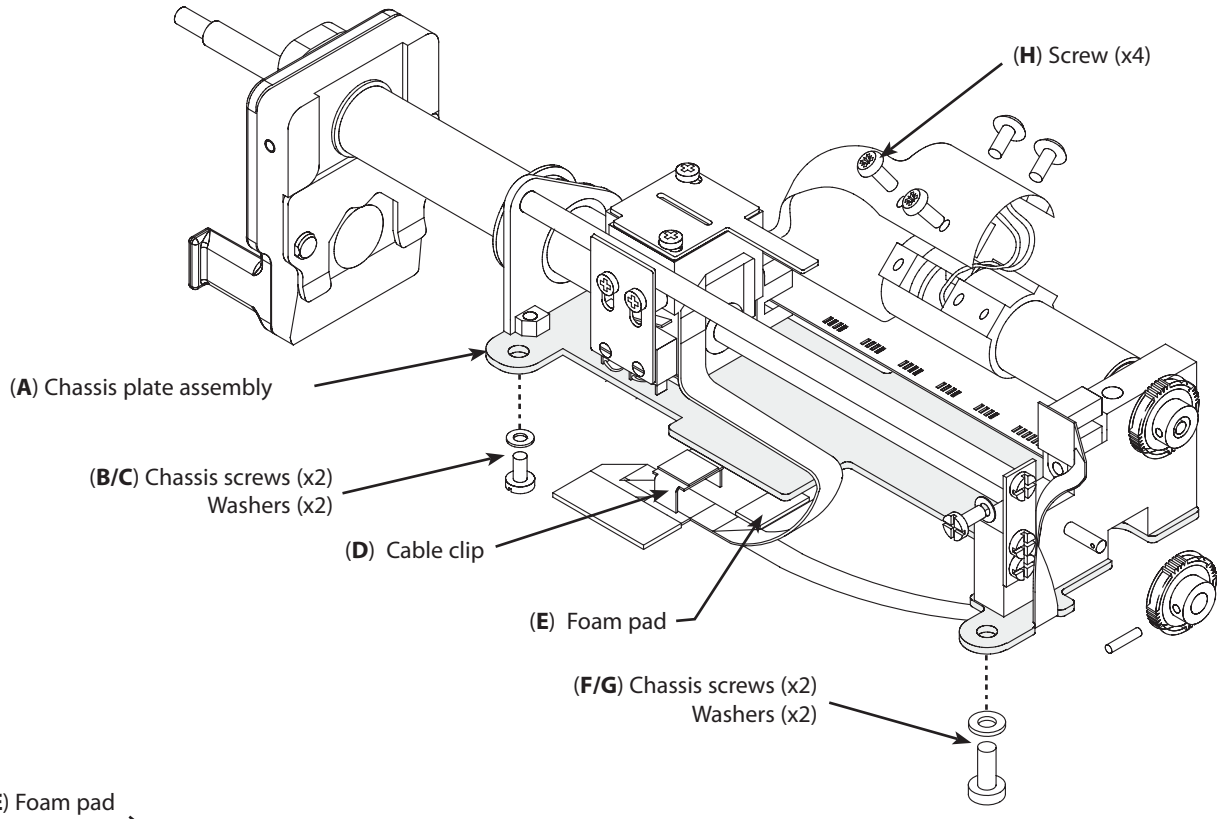
Item	Description	Part Number
A	PSERIES BEAM ASSEMBLY	1000SP00247
B	HEX NUT M3 STAINLESS STEEL,A4	0000ME00292
C	SEAL RING LEADSCREW	1000ME01048
D	ASSY LEADSCREW SEAL	1000SP01063
E	LEADSCREW V4	1000ME01011
F	PIN TENSION DIA 2.0X10mm	0000ME00016

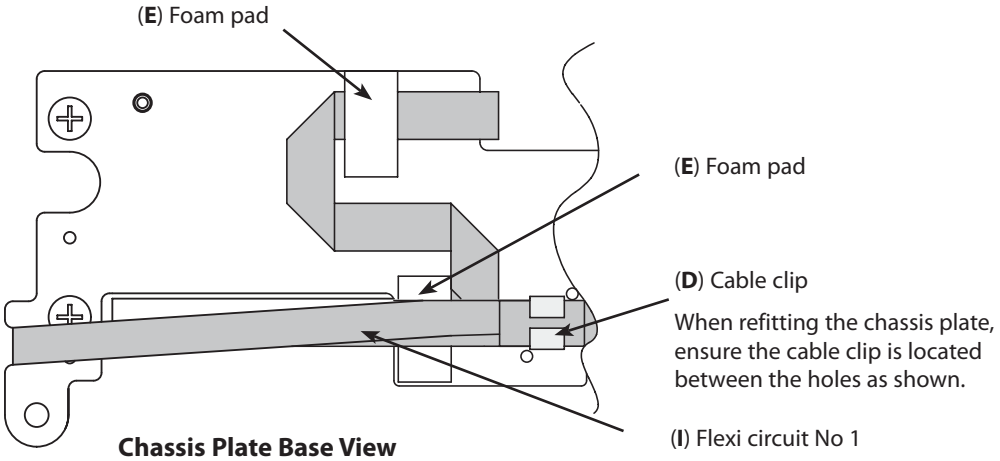
Transmission Assembly Breakdown *(continued)*

Chassis Plate

Replacement Procedure

1. Remove the four chassis plate assembly screws.
2. Remove the chassis plate, disconnecting flexi circuits as required. See also 'Flexi Circuits' on the next page.
3. Reassemble in reverse order.





Chassis Plate Base View

Spare Parts

Item	Description	Part Number
A	PLATE CHASSIS V4	1000ME01021
B	SCREW M3X6 PAN HD POSI ZP+P	0000ME00221
C	WASHER M3 WAVEY SST	0000ME00015
D	CLIP CABLE SELF ADHESIVE	0000EL00095
E	FOAM PAD CHASSIS PLATE	0000ME01066
F	SCREW M4X8 PAN HD POSI	0000ME00246
G	WASHER M4 WAVEY SST	0000ME00045
H	SCREW No4 X 1/4" PAN HD	0000ME00011
I	ASSY CIRCUIT FLEXIBLE No1 P1000-P3000/P5	1000SP01091

Transmission Assembly Breakdown *(continued)*

Flexi Circuits

Replacement Procedure

1. Disconnect the flexi circuit from the Control PCB.
2. Remove the four fixing screws and disconnect (de-solder) the motor wires (see Figure 1).
3. Disconnect (de-solder) flexi circuit from the microswitch.
4. Disconnect (de-solder) the flexi circuits from each other (see Figure 2). Remove the three screws securing the flexi circuit to the carriage block.
5. Disconnect the clip securing the flexi circuit to the base of the chassis plate (see Figure 3).
6. Reassemble in reverse order.

Note: See 'Carriage, Outer Tube and Plunger Assembly' for details of flexi circuit 2 removal.

Refitting note:
The two shorter flexi circuit fixing screws are fitted nearest to the motor.

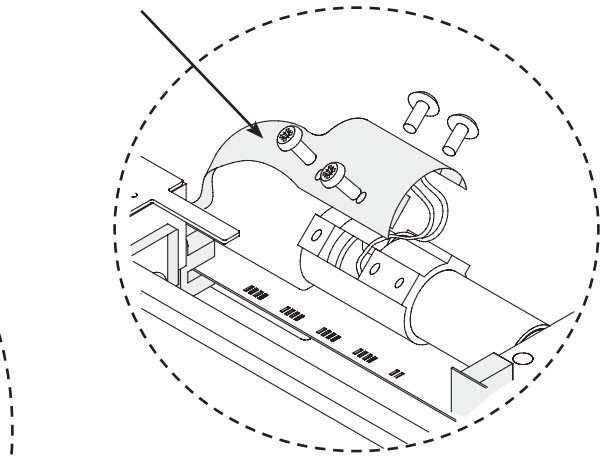


Figure 1.

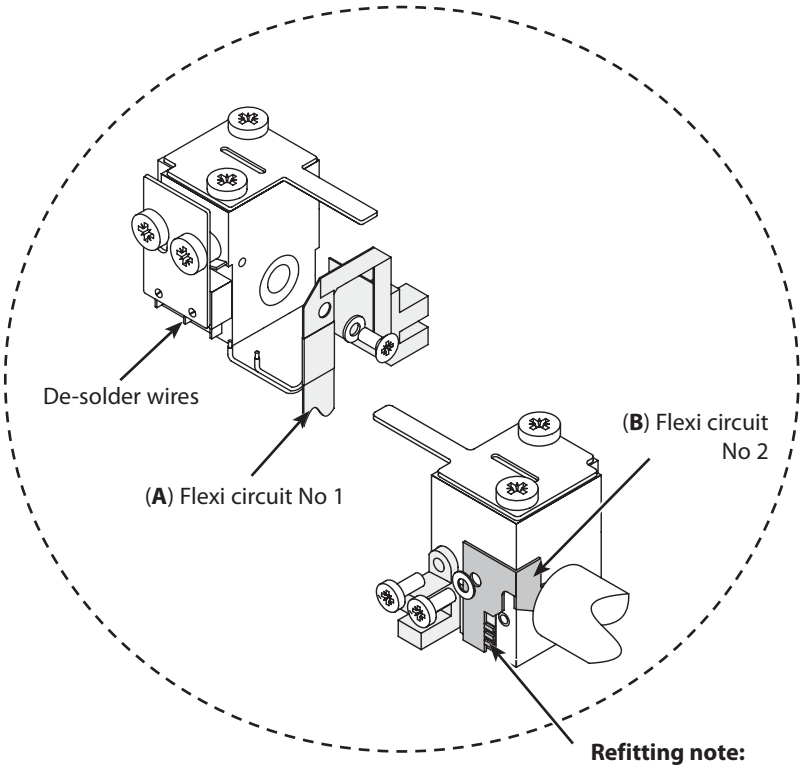


Figure 2.

Refitting note:
Fit flexi circuit No 1 first.

Take note of the fold formations and placement of the flexi circuit for reassembly.

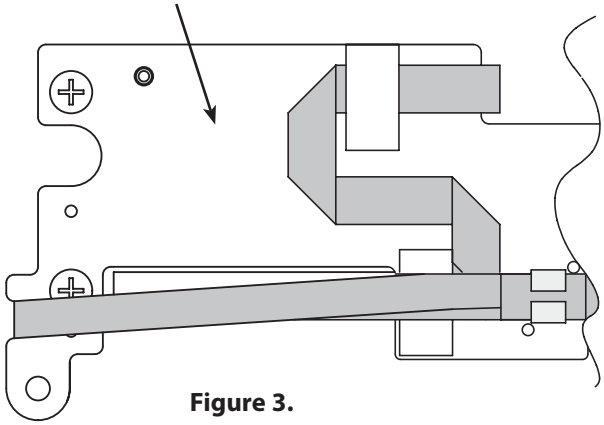


Figure 3.

Spare Parts

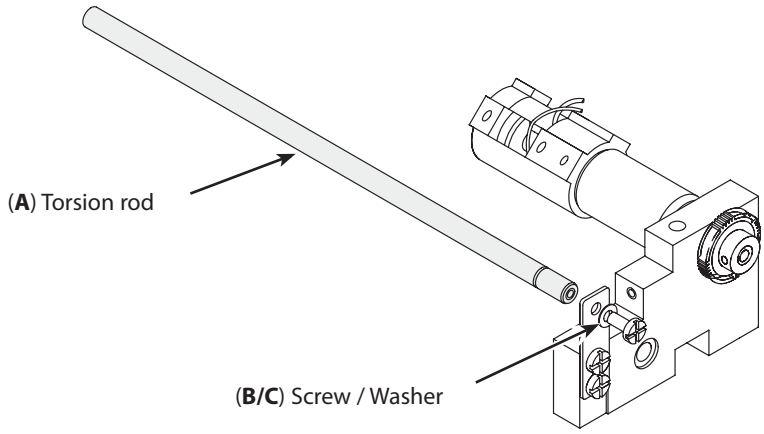
Item	Description	Part Number
A	ASSY CIRCUIT FLEXIBLE No1 P1000-P3000/P5	1000SP01091
B	ASSY CIR FLEXI NO.2	1000SP01007

Transmission Assembly Breakdown *(continued)*

Torsion Rod

Replacement Procedure

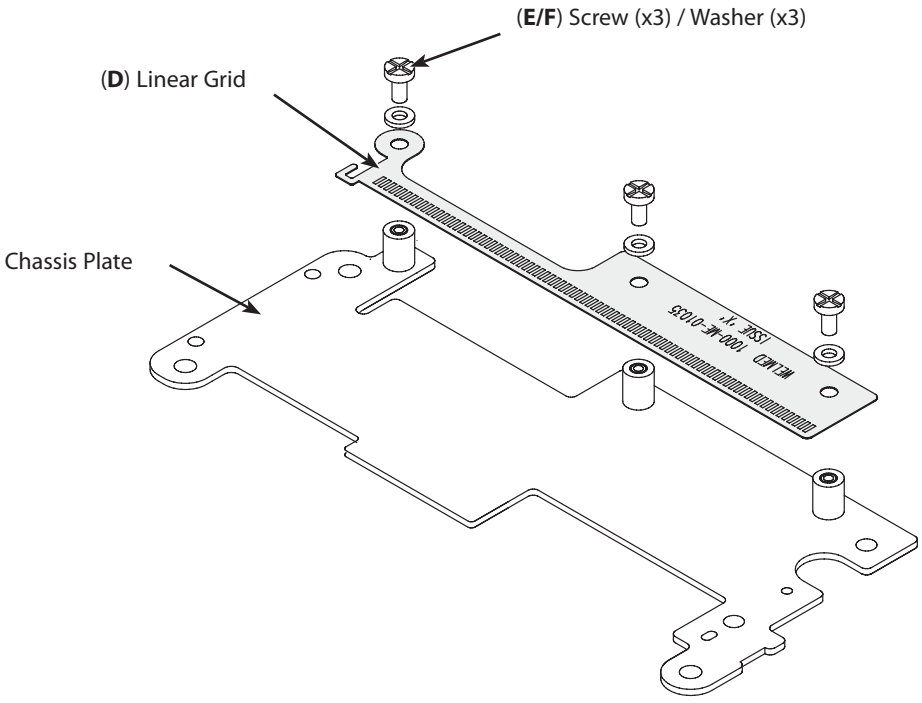
1. Remove the securing screw and washer then slide out torsion rod.
2. Reassemble in reverse order.



Linear Grid

Replacement Procedure

1. Remove the three retaining screws and washers.
2. Withdraw linear grid.
3. Reassemble in reverse order.



Spare Parts

Item	Description	Part Number
A	ROD TORSION P7000	7000ME00015
B	SCREW M3X6 PAN HD POSI ZP+P	0000ME00221
C	WASHER M3 WAVEY SST	0000ME00015
D	GRID LINEAR 1.5 PITCH V4	1000ME01035
E	SCREW M3X6 PAN HD POSI ZP+P	0000ME00221
F	WASHER M3 WAVEY SST	0000ME00015

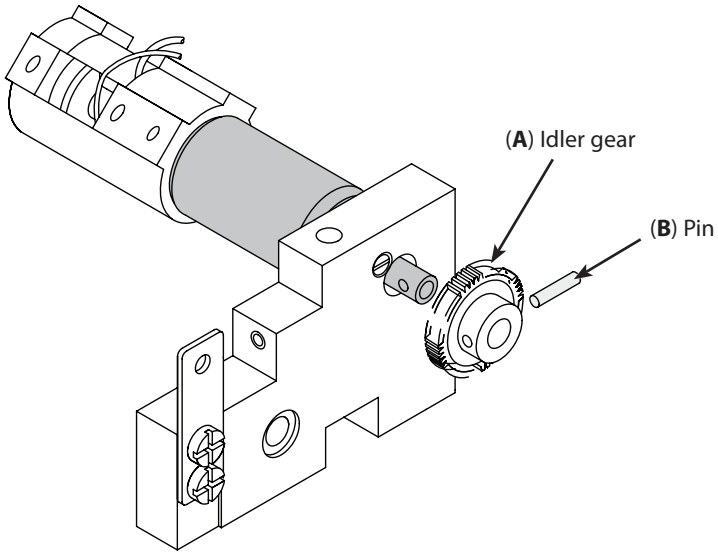
Transmission Assembly Breakdown *(continued)*

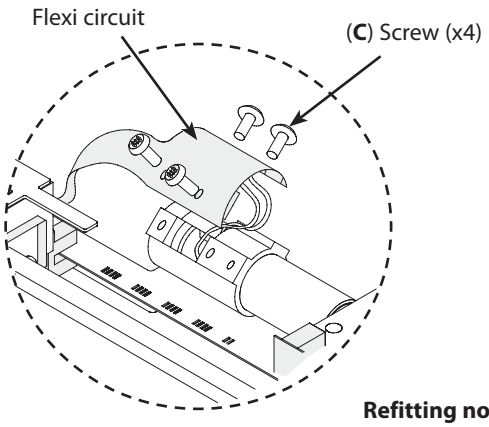
Motor Gearbox Assembly

Replacement Procedure

1. Remove the circlip, idler gear and washer from the spigot on the motor mounting plate.
2. Remove the securing pin, whilst supporting the motor shaft.
3. Disconnect the flexible circuit from the motor by removing the four fixing screws and disconnect (de-solder) the two motor wires.
4. Remove the two screws securing the motor assembly to the mounting plate.

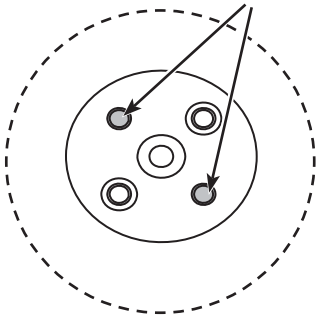
Procedure continued on the next page.





Refitting note:
The two shorter flexi circuit fixing screws are fitted nearest to the motor.

Figure 1. Motor Gearbox Breakdown



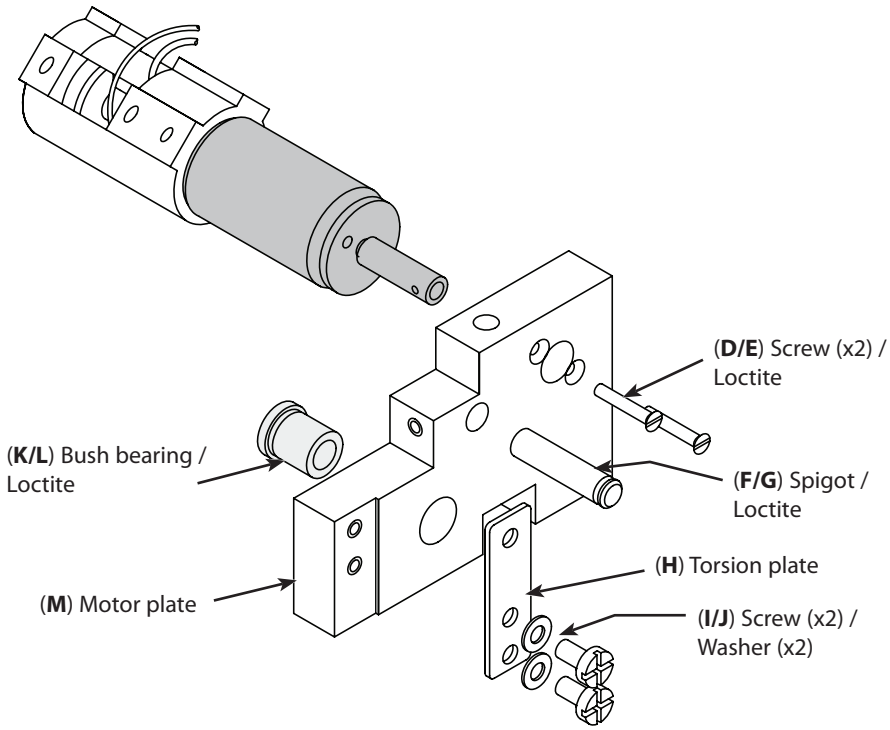


Figure 2. Motor Gearbox Breakdown

Transmission Assembly Breakdown *(continued)*

Motor Gearbox Assembly *(continued)*

Replacement Procedure (continued)

5. Remove the encoder flag and opto mount from the assembly.
6. Reassemble in reverse order.

Refitting notes:

1) When refitting the motor gearbox assembly to the motor mounting plate:
   - Apply loctite (221) to the screw thread ends
   - Fit screws into the two holes *without* rings around them
2) When soldering the motor wires to the flexi circuit, the black wire is soldered to the terminal marked '+'.
3) When refitting the encoder flag to the opto mount, apply torque level of 25cNM to the securing screw (item **O.1**).

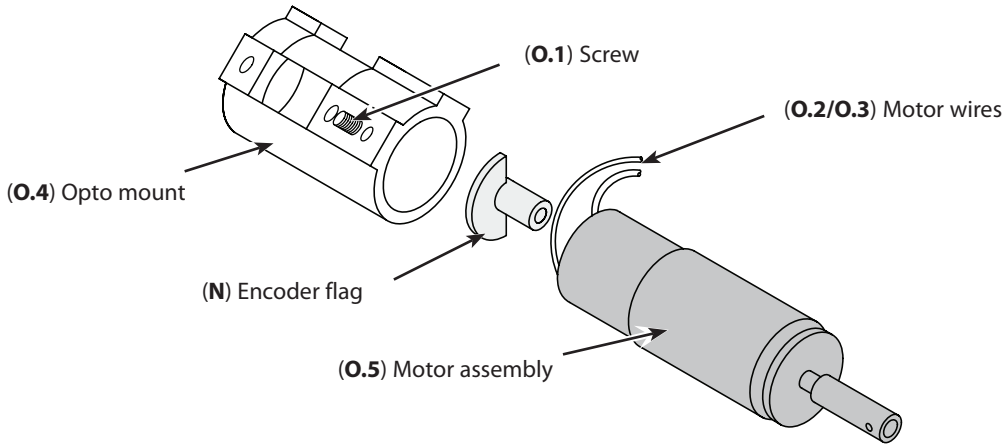


Figure 3. Motor Gearbox Breakdown

- **Ensure the motor encoder flag rotates freely and does not strike the motor opto switches when refitting the motor gearbox assembly**
- **Keep the motor wires out of the way when refitting the rotating encoder flag**

Spare Parts

Item	Description	Part Number
A	GEAR TRANSMISSION 35T P1	1000ME01109
B	PIN TENSION DIA 2.0x10mm	0000ME00016
C	SCREW No4 X 1/4" PAN HD	0000ME00011
D	SCREW M2x12 CSK HD SLOTTED	0000ME00084
E	ADHESIVE LOCTITE 243	0000ME00672
F	SPIGOT IDLER	1000ME00010
G	ADHESIVE LOCTITE 603	0000ME00107
H	PLATE TORSION MOTOR END	1000ME00048
I	SCREW M3x6 PAN HD POSI ZP+P	0000ME00221
J	WASHER M3 WAVEY SST	0000ME00015
K	BUSH M0TOR BEARING MOULDED	1000ME01113
L	ADHESIVE LOCTITE 495	0000ME00052
M	PLATE MOTOR MOUNTING P1000/2000/3000/500	1000ME01012
N	ENCODER MOTOR	1000ME00174
O	SPARE MTR G/BOX V2/V4 P SERIES	1000SP00030
O.1	SCREW M3x5 CSK SET CUP	0000ME00009
O.2	CABLE BLACK 7/0.2	0000EL00100
O.3	CABLE RED 7/0.2	0000ME00101
O.4	MOUNT OPTO MOULDED	1000ME01399
O.5	MOTOR G/BOX V4 ASSY P1000-3000/P5000	1000SP01042

Transmission Assembly Breakdown *(continued)*

Carriage, Outer Tube and Plunger Assembly

Replacement Procedure

1. To breakdown the carriage, outer tube and plunger assembly, refer to the diagrams on the following pages (Figures 1, 2, 3 and 4), removing components as required.
2. Reassemble in reverse order.

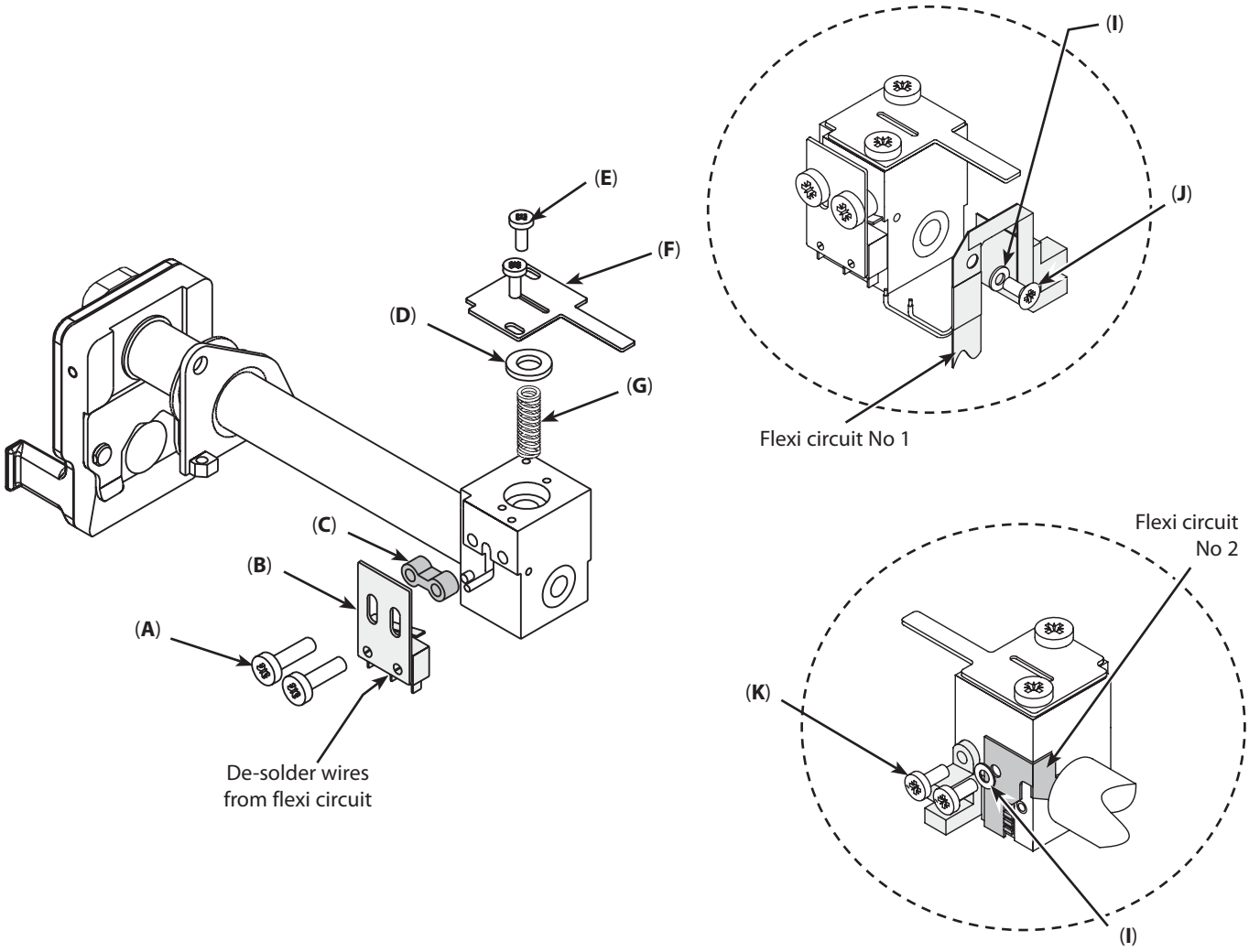


Figure 1. Transmission Assembly Breakdown

Spare Parts

Item	Description	Part Number
A	SCREW No4x1/2" PAN HD	0000ME00032
B	ASSY MICROSWITCH V4	1000SP01022
C	SPACER DUAL TRANSMISSION	1000ME00177
D	WASHER 12X1.6X6.4 I/D NYLON	0000ME00391
E	SCREW No3x3/8" PAN HD	0000ME00031
F	ACTUATOR NEOI	1000ME00108
G	SPRING COMP OD 6.1 19 LONG	0000ME00003
I	FLAT WASHER NYLON M3 TO ISO 7089	0000ME00044
J	SCREW No4x1/4" CSK TRUNCATED POZI SS	0000ME00313
K	SCREW No4x1/4" PAN HD	0000ME00011
*	SPARES KIT BRAUN OPTION	1000SP00211
*	SPARES KIT JANPOL OPTION	1000SP00212

* Syringe option kits, not shown.

Transmission Assembly Breakdown *(continued)*

Carriage, Outer Tube and Plunger Assembly *(continued)*

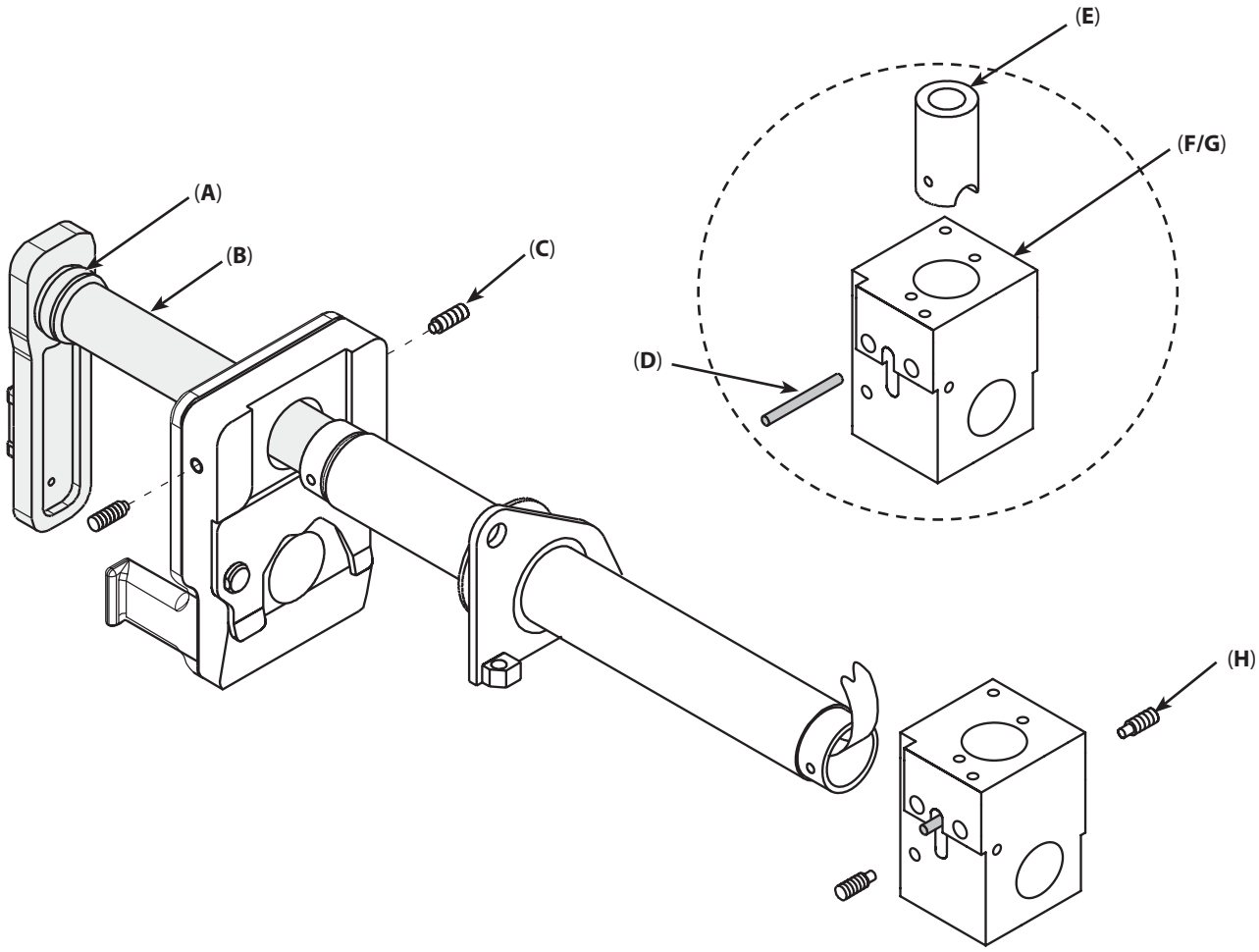


Figure 2. Transmission Assembly Breakdown

Refitting notes:

1) Apply torque level of 45cNM when securing the two plunger holder screws (item **C**).
2) Apply torque level of 25cNM when securing the two carriage block screws (item **H**).

Spare Parts

Item	Description	Part Number
A	O RING NITRILE 11.5X1.5	0000ME00277
B	LEVER TUBE DECLUTCH	1000SP01084
C	SCREW M3X8 TORX T6 SET PART DOG	1000ME01134
D	PIN TENSION DIA 2.0X20mm	0000ME00018
E	HALF NUT V4	1000ME00097
F	CARRIAGE V4	1000ME01013
G	GREASE SILICONE	0000ME00058
H	SCREW M3X8 TORX T6 SET FULL DOG	1000ME01133

Transmission Assembly Breakdown *(continued)*

Carriage, Outer Tube and Plunger Assembly *(continued)*

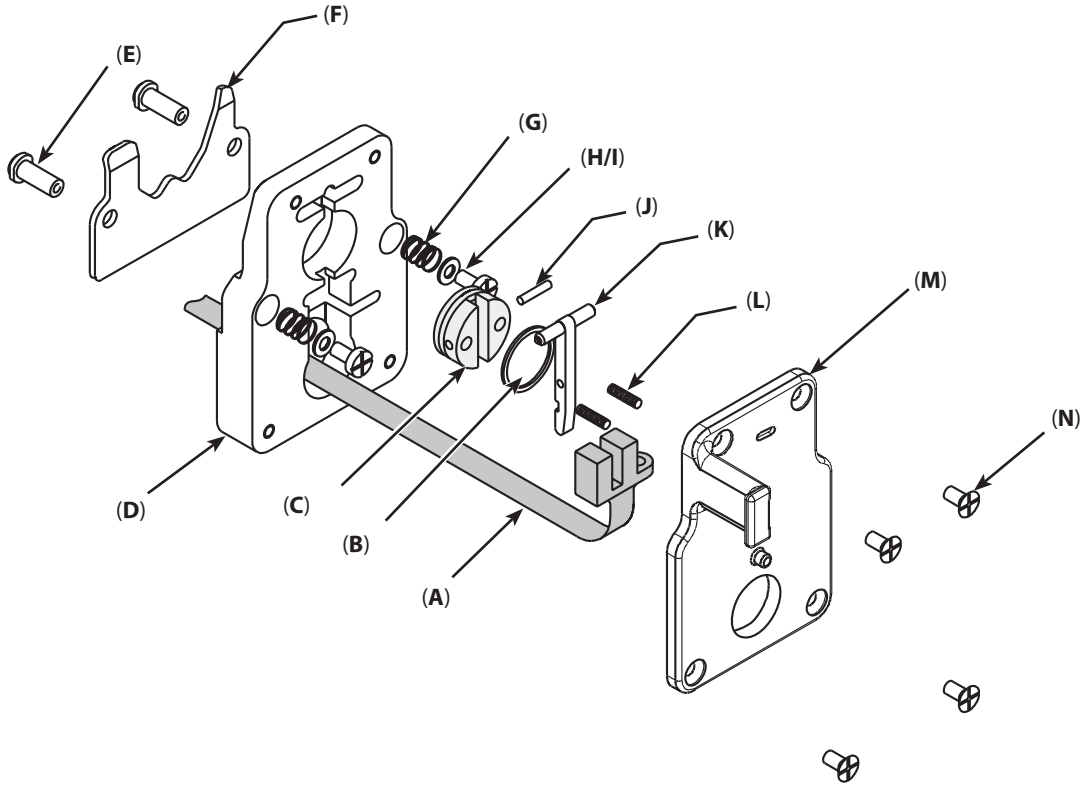


Figure 3. Transmission Assembly Breakdown

Spare Parts

Item	Description	Part Number
A	ASSY CIR FLEXI NO.2	1000SP01007
B	O RING 13.0 I/D x 1.5	0000ME00136
C	BUTTON PLUNGER HOLDER MOULDED	1000ME01114
D	HOLDER PLUNGER V4	1000ME01059
E	PIN PLUNGER PLATE	1000ME01027
F	PLATE PLUNGER RESTRAINT	1000ME01305
G	SPRING MUSIC WIRE	0000ME00386
H	WASHER M3 PLAIN Z+C	0000ME00048
I	SCREW M3X6 PAN HD POSI ZP+P	0000ME00221
J	SPIROL PIN 1.5X10 MDP	0000ME00132
K	HOLDER PLUNGER CRUCIFORM MKII	1000ME01353
L	SPRING COMPRESSION 2.24 DIAX7.9mm	0000ME00133
M	BACKPLATEPLUNGER HOLDER OVERMOL	1000ME01325
N	SCREW M3X8 CSK HD POSI SS	0000ME00268

Transmission Assembly Breakdown *(continued)*

Carriage, Outer Tube and Plunger Assembly *(continued)*

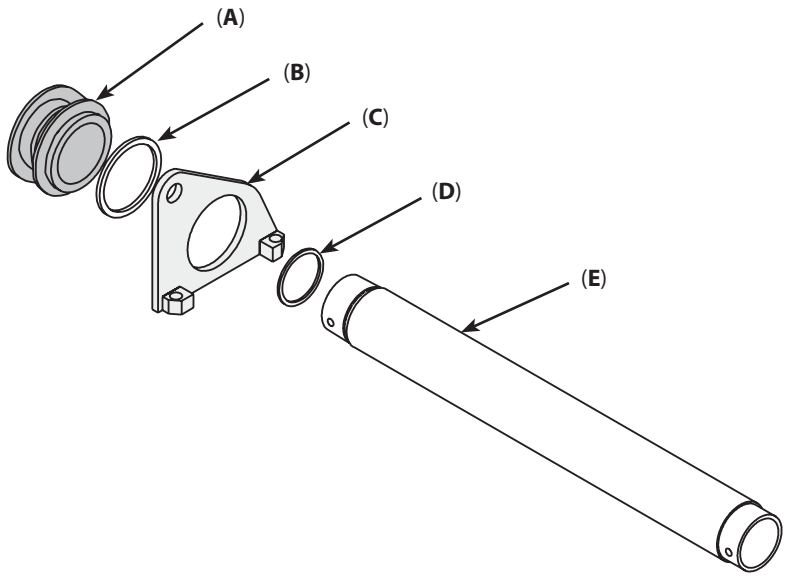


Figure 4. Transmission Assembly Breakdown

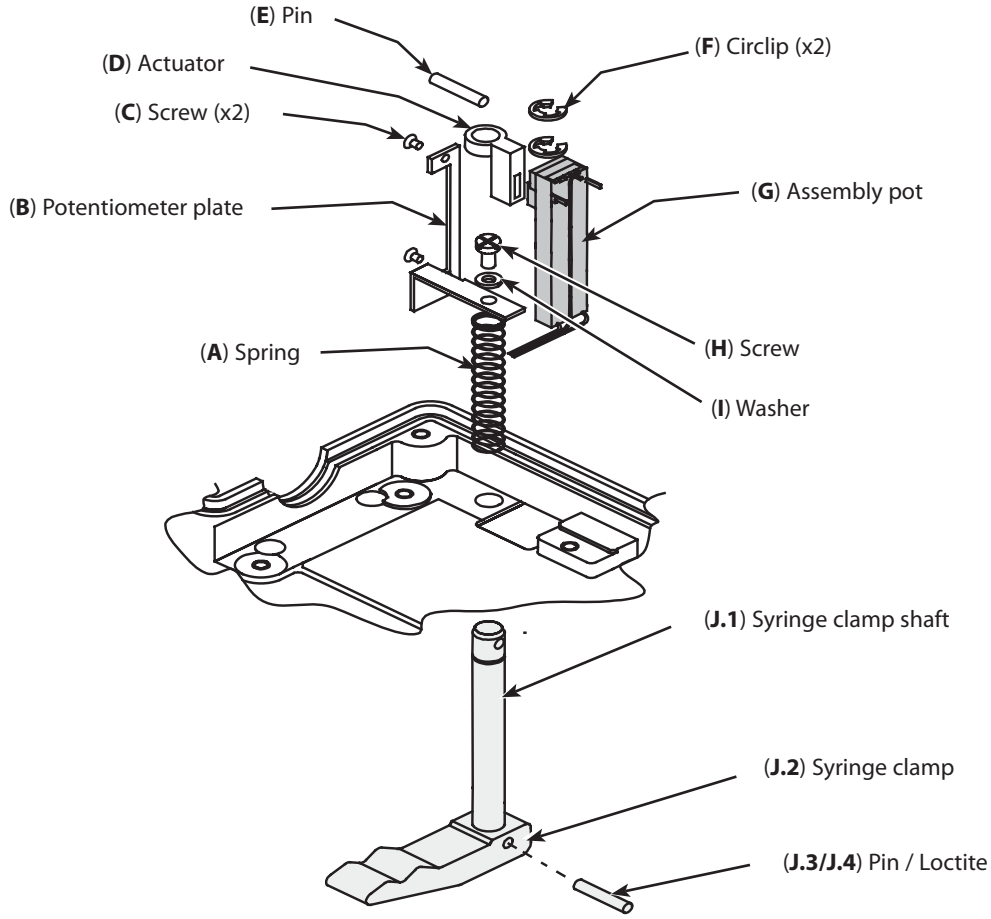
Spare Parts

Item	Description	Part Number
A	SEAL OUTER TUBE RECESSED	1000ME01121
B	SEAL RING OUTER TUBE	1000ME01047
C	PLATE OUTER TUBE SEAL V4	1000ME01022
D	O RING 13.0 I/D x 1.5	0000ME00136
E	TUBE OUTER 'O' RING GROOVE	1000ME01122

Syringe Size Pot, Syringe Clamp

Replacement Procedure

1. Remove the securing pin from the syringe shaft assembly. Remove the potentiometer actuator from the syringe shaft assembly.
2. Remove the screw and washer securing the potentiometer assembly then remove the potentiometer assembly.
3. Remove the two circlips securing the syringe shaft assembly spring.
4. Remove the syringe shaft assembly from the upper case.
5. Reassemble in reverse order.



Spare Parts

Item	Description	Part Number
A	SPRING COMP OD 7.62 44 LONG	0000ME00110
B	PLATE POTENTIOMETER PUNCHED	1000ME00207
C	SCREW M2x3 CSK HD SLOTTED	0000ME00164
D	ACTUATOR POTENTIOMETER MOULDED	1000ME00175
E	PIN TENSION DIA 3.0x16mm	0000ME00116
F	CIRCLIP	0000ME00112
G	ASSY POTENTIOMETER 50K	1000SP01017
H	SCREW M3x6 PAN HD POSI ZP+P	0000ME00221
I	WASHER M3 WAVEY SST	0000ME00015
J	ASSY SYRINGE CLAMP BONDED P5	5000SP00046
J.1	SHAFT SYRINGE CLAMP P5000	5000ME00078
J.2	CLAMP SYRINGE MACH. V4	1000ME01006
J.3	PIN TENSION 3.0x10.0	0000ME00257
J.4	ADHESIVE LOCTITE 603	0000ME00107

Syringe Size Pot, Syringe Clamp (*continued)*

Recommended when serviced
Bond syringe clamp if the pump serial number is within the range 5001-00083 to 5001-02910.

Procedure:

1) Remove the two circlips and spirol pin that secure the syringe clamp assembly in the upper case then slide the syringe clamp assembly out through the bush in the upper case. The potentiometer assembly and actuator can be left in place.
2) Carefully knock out the syringe shaft spirol pin, clean out the syringe shaft hole and apply Loctite (item J.4), or equivalent adhesive around the edge of the hole.
3) Reassemble the syringe clamp assembly, re-inserting the pin through the hole in the clamp and shaft.
4) Wipe off excessive adhesive and allow to cure for a minimum of 3 hours before refitting the syringe clamp assembly into the pump. Note: If cure time of 3 hours cannot be tolerated, activators may be used to reduce the cure time.

Cover Lock Assembly, Case Sealing Cord

Replacement Procedure

1. Remove the sealing cord from the groove in the upper case. Note the recommended joint position (see illustration below).
2. Remove the two extension springs from the lock cam and the rod then remove the spring plate by removing the fixing screw, then the washer.
3. Remove the lock nut from the back of the mechanical lock, then remove the cam and the washers.

To prevent the lock components separating when the lock barrel is removed from the lock body, ensure the key is in the lock.

4. Remove the nut securing the lock to the upper case and remove the lock body, including the sealing washer from the case.
5. Remove the rod support retaining screw then remove the circlip and the set cup screw from the latch cam.
6. Remove the latch cam, O-ring and the rod from the case. Note: The washer and the rod support will still be on the rod.
7. Reassemble in reverse order. See 'Refitting notes' including 'Latch Cam Refitting Tip' on the next page.

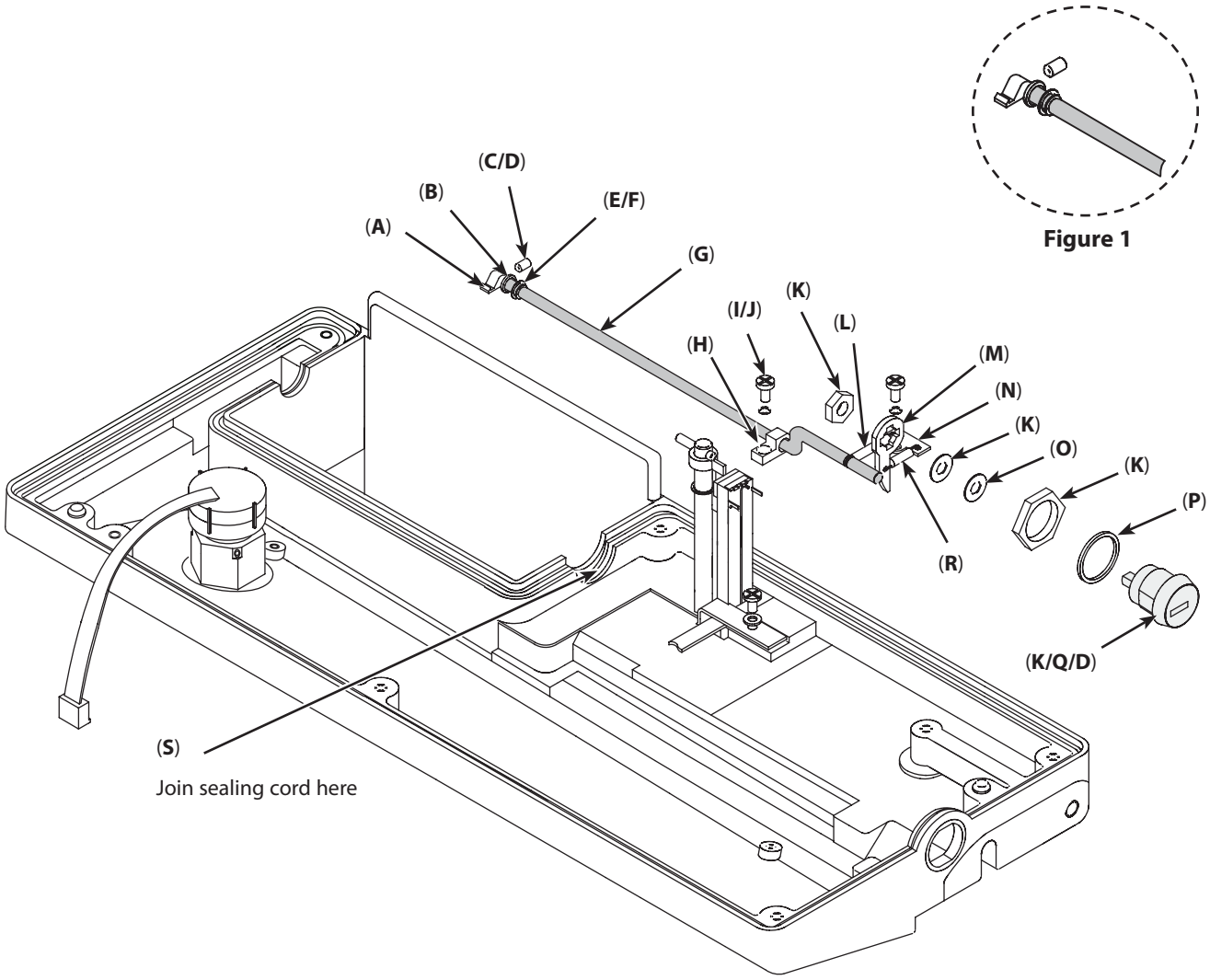


Figure 1

Cover Lock Assembly, Case Sealing Cord *(continued)*

Refitting notes:

1) Orientate the circle etched on the lock barrel towards the front when inserting the lock into the case.
2) Ensure the lock assembly is not assembled too tightly.
3) Use retaining adhesive (for example, loctite 638) on the nut which secures the lock to the upper case.
4) Fit the latch cam, O-ring, washer and set cup screw (see Figure 1) when the rod is in position. When tightening the set cup (grub) screw, it is important to ensure there is no lateral movement between the latch cam and the case.

Latch Cam Refitting Tip
To prevent any lateral movement between the latch cam and the case, tighten the set cup (grub) screw as follows:

- **Hold the left end of the rod in position (away from the case side, biased from left to right), whilst pushing the latch cam from right to left and fixing the grub screw.**
- **Once complete, check from the outside that the latch is firmly butted up against the washer at the leftmost position, without any sideways movement.**

5) Use Loctite 243 on the socket set cup screw when fixing the latch cam to the rod.
6) On completion, check the lock mechanism operates correctly.

Spare Parts

Item	Description	Part Number
A	LATCH CAM	5000ME00031
B	O RING 3.0 I/D x 1.5	0000ME00160
C	SCREW M3x5 CSK SET CUP	0000ME00009
D	ADHESIVE LOCTITE 243	0000ME00672
E	WASHER M3 PLAIN Z+C	0000ME00048
F	CIRCLIP E TYPE 2.3mm ID SS DIN 6799	0000ME00320
G	ROD	5000ME00032
H	ROD SUPPORT	5000ME00074
I	SCREW M3x6 PAN HD POSI ZP+P	0000ME00221
J	WASHER M3 WAVEY SST	0000ME00015
K	SPEC MECHANICAL LOCK	5000ME00055
L	SPRING EXTENSION	0000ME00169
M	PLATE LOCK CAM	5000ME00012
N	PLATE SPRING	5000ME00053
O	WASHER 13.5 X 9.61 X 0.5 NYLON	0000ME00186
P	WASHER 18.35 X 15.91 X 0.75 NYLON	0000ME00188
Q	GREASE SILICONE	0000ME00058
R	SPRING EXTENSION	0000ME00170
S	CORD SEALING SILICONE ID 0.95	1000ME01087

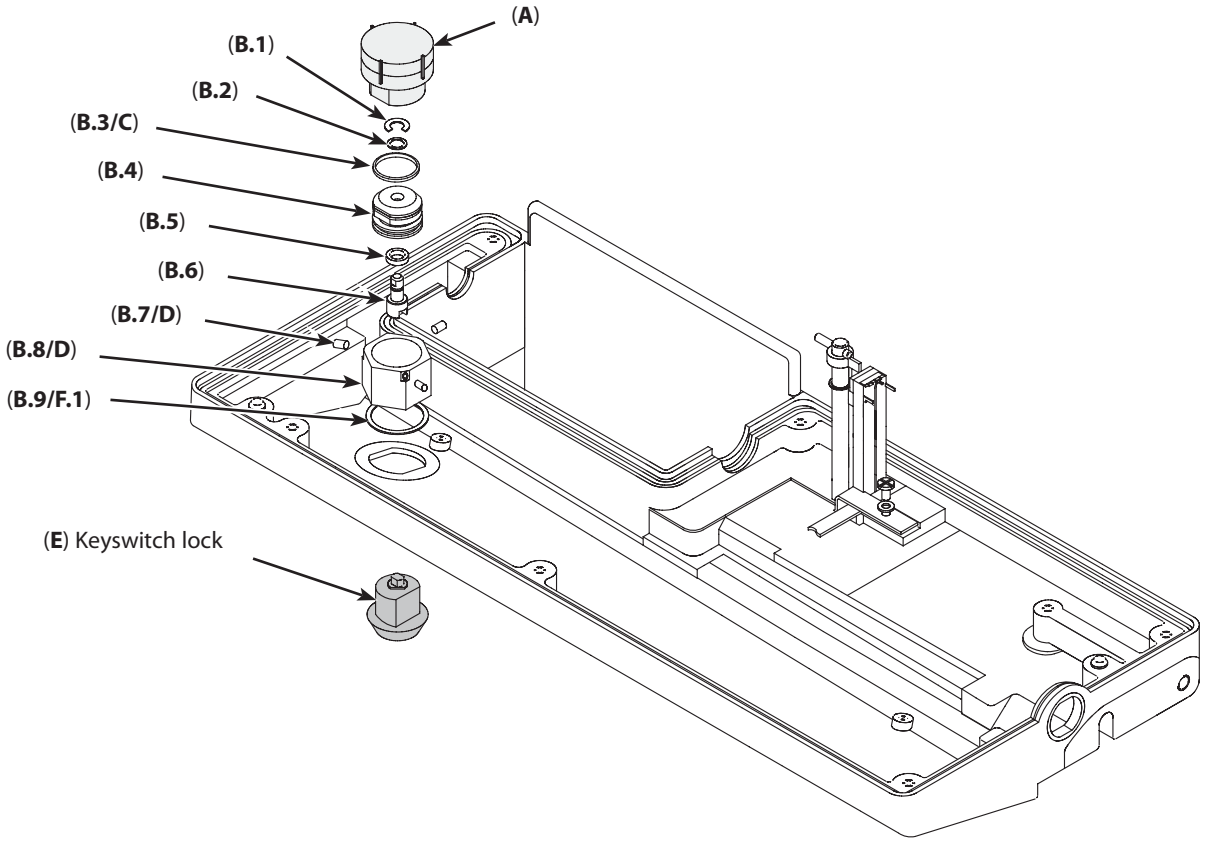
Keyswitch Assembly

Replacement Procedure

1. Prise off the keyswitch (item **A**).
2. Remove the three retaining grub screws from the lock seal body. Remove the lock seal body, the lock sealing nut and washer from the assembly.
3. Remove the keyswitch lock assembly.
4. Reassemble in reverse order.

Refitting notes:

1) Apply Loctite (243) to the lock sealing nut and to the grub screws before refitting items to the keyswitch assembly.
2) Ensure the lock spindle is correctly located in the groove in the lock seal body.
3) Ensure the keyswitch lock is orientated correctly (at the OFF position) when refitting the lock into the upper case.
4) On completion, check that the keyswitch assembly operates correctly.



- **Fit replacement keyswitch assembly (5000SP00035) if the pump build issue is 56 or below**
- **Fit replacement keyswitch sealing washer (5000ME00081) and additional keyswitch assembly tie wrap (0000EL00099) if the pump serial number is within the range 5001-00094 to 5001-01006**
- **Fit additional keyswitch sealing washer (5000ME00081) if the pump build issue is 52 or below. Spares kit 5000SP00034.**

Keyswitch Assembly

Spare Parts

Item	Description	Part Number
A	ASSY KEYSWITCH	5000SP00001
B	SPARE UPGRADE KEY SWITCH ASSY	5000SP00035
B.1	CIRCLIP E TYPE SHAFT DIA 4.8	0000ME00002
B.2	WASHER M5 PLAIN Z+C	0000ME00027
B.3	O RING 15.10 X 1.60	0000ME00256
B.4	LOCK SEAL BODY P5000	5000ME00088
B.5	O RING 4.47 I/D x 1.78	0000ME00161
B.6	LOCK SEAL SPINDLE P5000	5000ME00089
B.7	SCREW M3x5 CSK SET CUP	0000ME00009
B.8	LOCK SEALING NUT P5000	5000ME00090
B.9/F.1	WASHER KEYSWITCH SEALING	5000ME00081
C	GREASE SILICONE	0000ME00058
D	ADHESIVE LOCTITE 243	0000ME00672
E	SPARES KIT PCAM KEYSWITCH LOCK	1000SP00266
F	SPARE UPGRADE KEYS WASHER "KW"	5000SP00034
*	SPARE KEY ELEC/MECH P5000	5000SP00010

* item not shown

Window Display, Front Panel Label

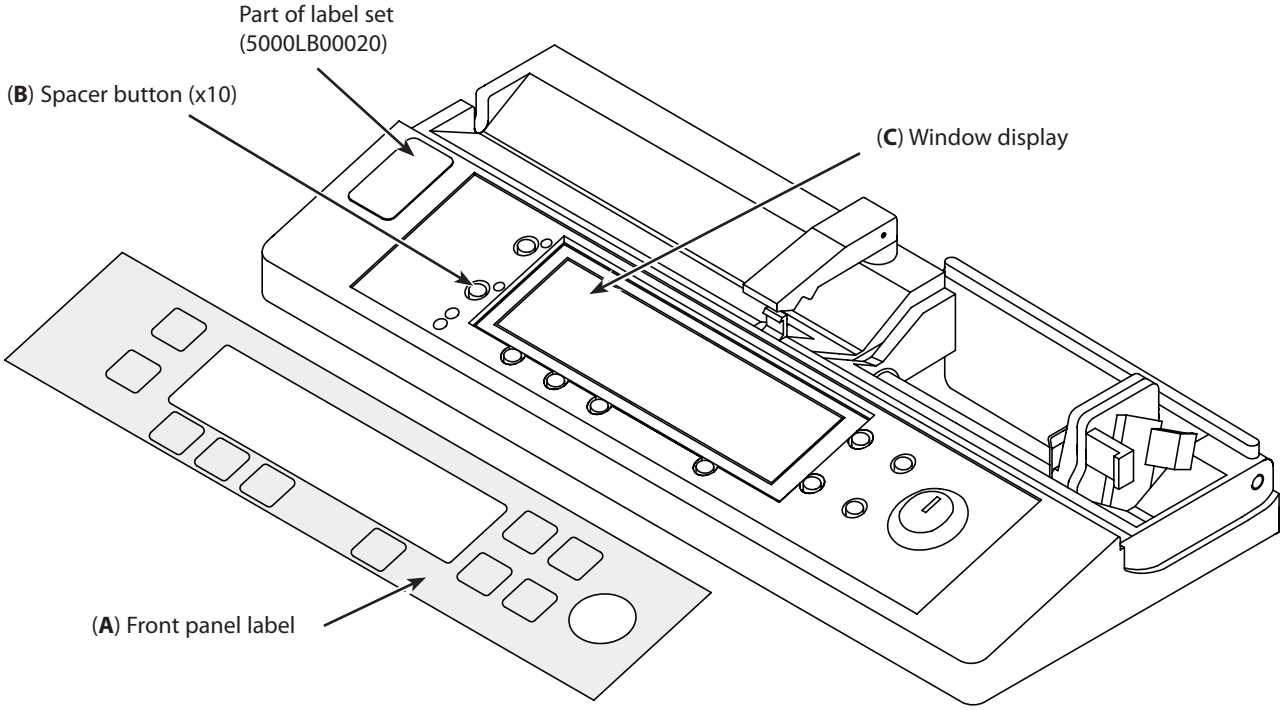
Replacement Procedure

1. Remove the front panel label and discard. Front panel labels cannot be reused.
2. Remove spacer buttons as required. Note: See 'Display PCB' for further information on spacer buttons and replacement instructions.
3. Clean surface where replacement front panel label is to be fitted.
4. Lift out display window.
5. Reassemble in reverse order.

Refitting note:

When fitting a new front panel, start from the left-hand edge, peel off backing and press into place, carefully aligning the panel in the recess.

Fit clip-on rubber spacer buttons (5000ME00108) if the pump has a poor button tactile response. See 'Display PCB' for further information.



Spare Parts

Item	Description	Part Number
A	LABEL FP UNIV P5000	5000LB00023
B	SPACER BUTTON F/P CLIPON	5000ME00072
C	WINDOW DISPLAY	5000ME00008

Cover, Spring Mechanism

Replacement Procedure

1. Remove the two cover retaining screws and two hinge sleeves.
2. Remove the blanking plate label. Remove the exposed spring mechanism assembly fixing screws and remove the assembly from the cover.
3. Remove the compression spring then the spring arm from the spring mechanism assembly.
4. Reassemble in reverse order.

Refitting notes:

1) Apply loctite (item B) to each cover hinge (item A.4) before assembly.
2) When reassembling the magnet holder and the spring mechanism, ensure ends **1** are inserted first, then ends **2** as shown in Figure 1.

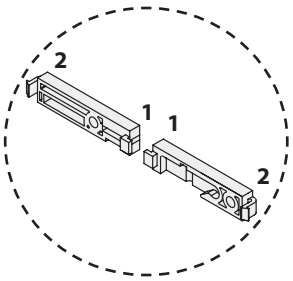
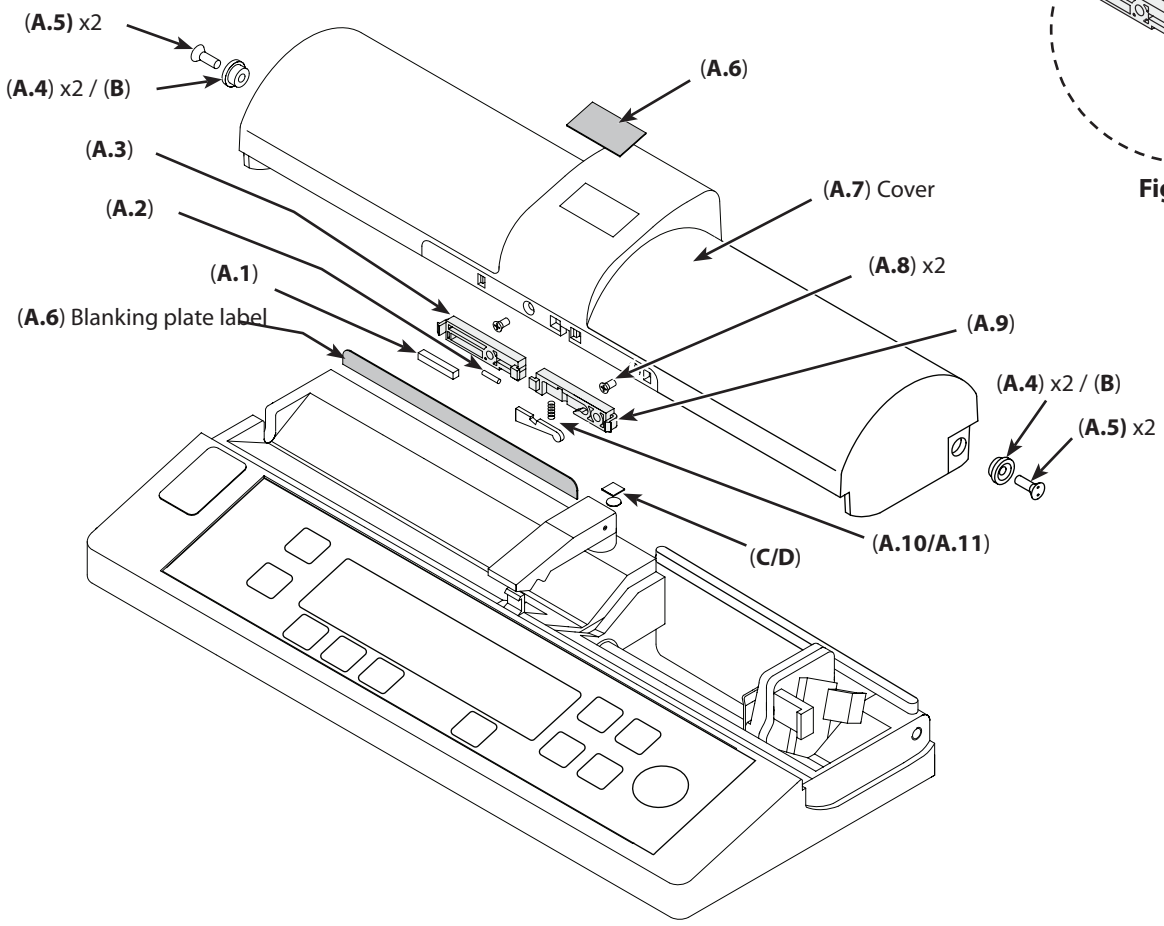


Figure 1



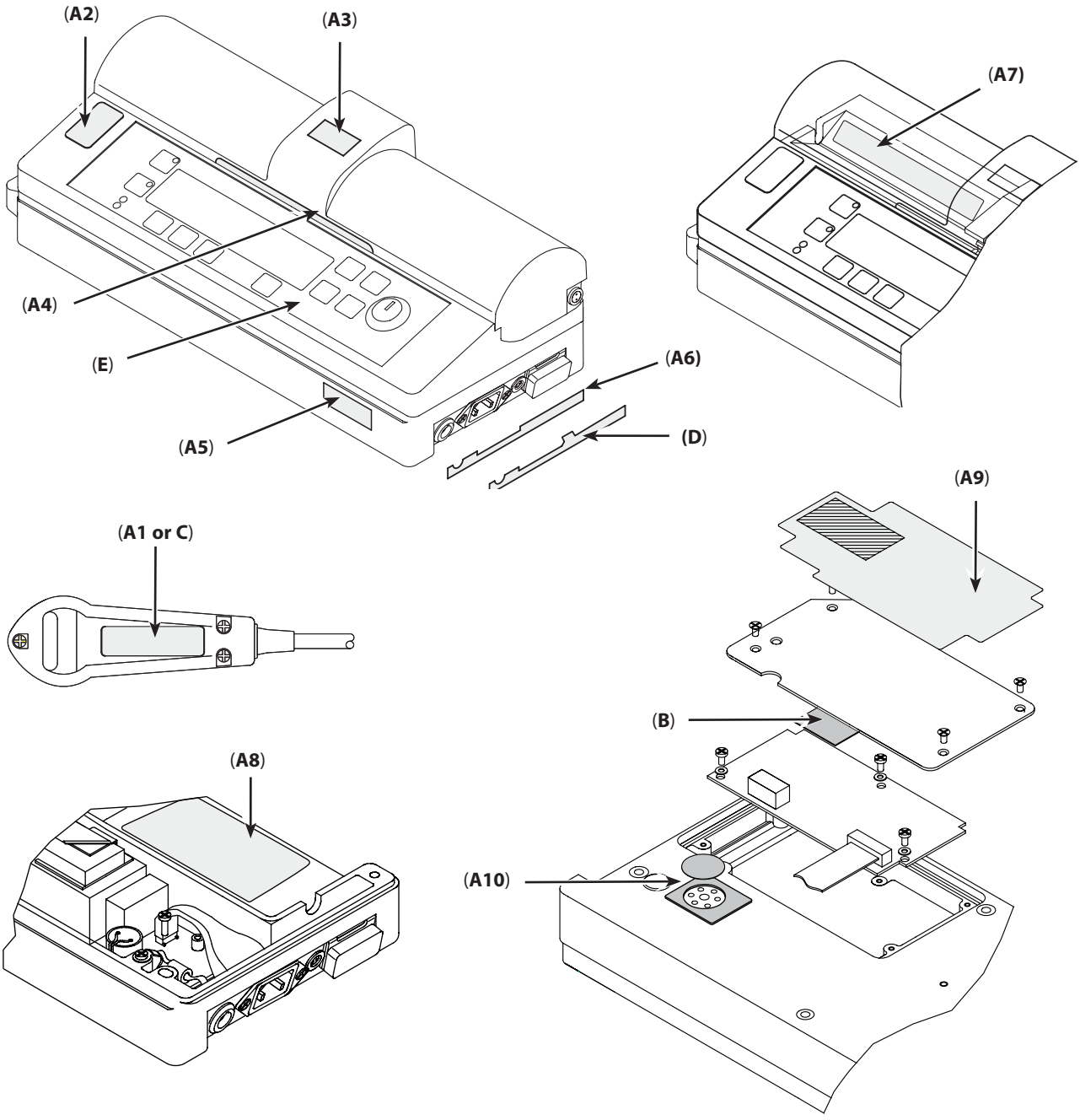
- **Fit replacement spring mechanism (5000ME00095) if the pump build issue is 10 or below, where the throw of the cover needs increasing.**
- **The replacement cover (5000SP00040) has increased headroom to accommodate a 100ml syringe. Fit replacement cover where required.**

Cover, Spring Mechanism *(continued)*

Spare Parts

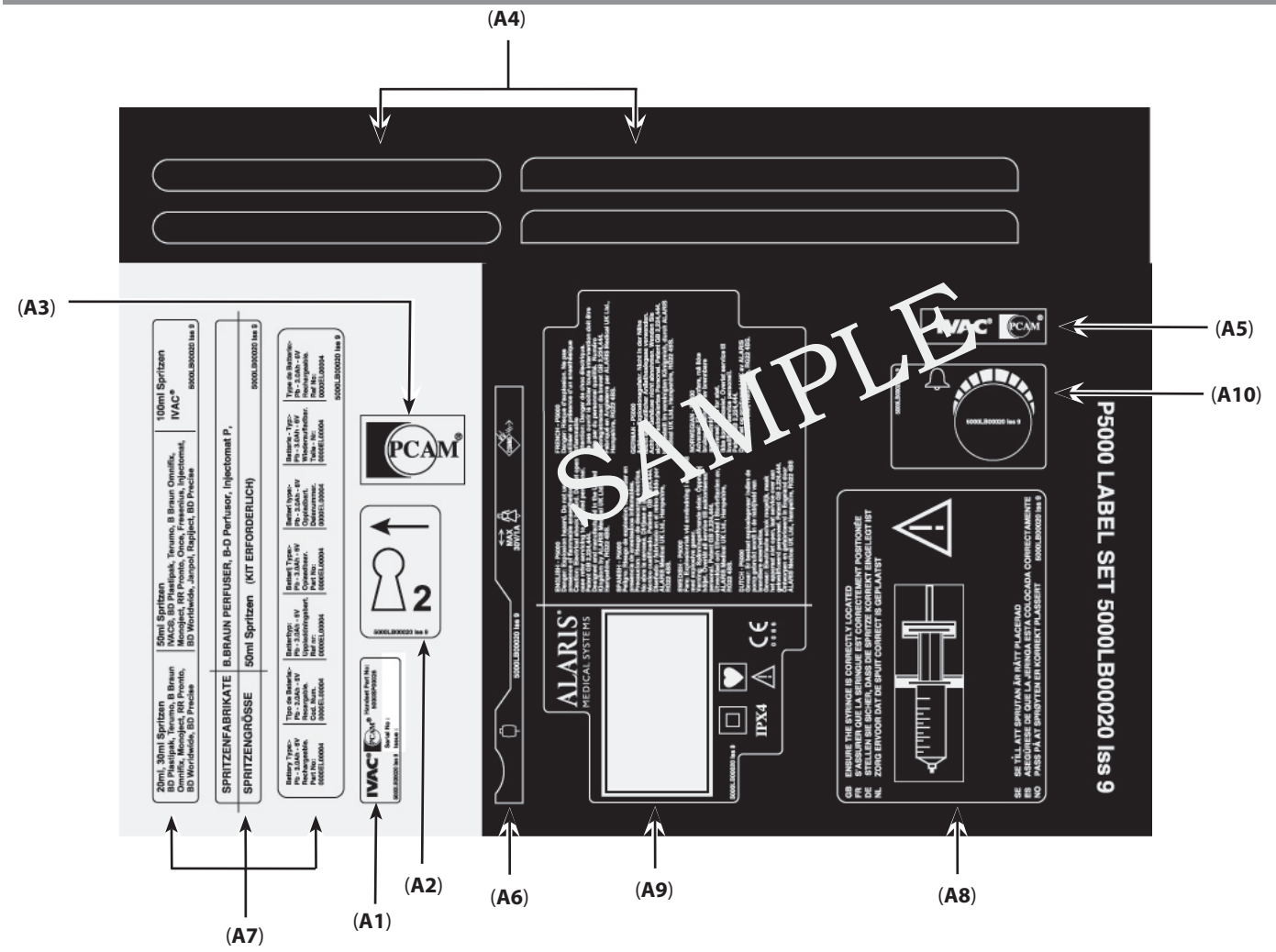
Item	Description	Part Number
A	SPARE UPGRADE COVER PCAM	5000SP00040
A.1	COVER MAGNET LATCH	0000ME00156
A.2	PIN DOWEL M2X10 H&G	0000ME00278
A.3	MOULDING MAGNET/CATCH	5000ME00094
A.4	SLEEVE COVER HINGE	5000ME00096
A.5	SCREW M4x12 CSK SNAKE EYE	0000ME00157
A.6	LABEL SET P5000	5000LB00020
A.7	COVER MOULDED PCAM	5000ME00099
A.8	SCREW M3x6 CSK HD POSI 1 Z+BLACK	0000ME00222
A.9	MOULDING BODY SPRING MECHANISM	5000ME00095
A.10	SPRING COMPRESSION	0000ME00183
A.11	ARM SPRING	5000ME00052
B	ADHESIVE LOCTITE 243	0000ME00672
C	LABEL COVER SPRING ARM BUFFER	5000ME00066
D	DISC DOUBLE SIDED TAPE	0000ME00102

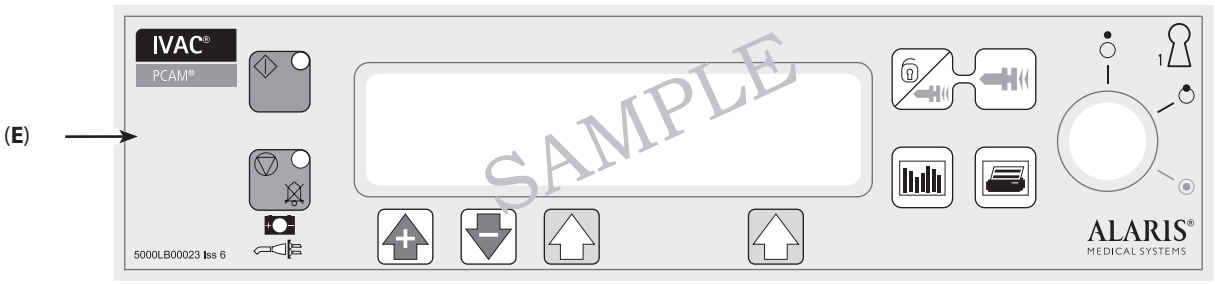
Labels



Fit item F - alarm cover label (1000SP01045) to decrease alarm volume if the alarm volume is still too loud at it's lowest position.

Labels *(continued)*





A	LABEL SET P5000	5000LB00020
B	LABEL BASE PANEL 30x30	1000LB00016
C	LABEL P5 HANDSET	5000LB00021
D	LABEL SET END V4/P7	1000LB01015 (pump without Nursecall)
E	LABEL FP UNIV P5000	5000LB00023
F	SPARE KIT ALARM COVER LABEL	1000SP01045
*	INSTRUMENT LABEL 1" X 1 1/2	1000LB00059

* item not shown. This is a roll of blank combined serial number and status label. Transfer information from old label. This label should be used in conjunction with the clear protective cover from the universal label set.

Appendix A

Specifications

In this chapter

The following information is for reference purposes only. For more detailed specifications refer to relevant *DFU*.

Infusion

Concentration range	**Mass/Volume Mode:**	**1µg/ml - 999µg/ml in 1µg/ml steps**
		1.0mg/ml - 99.9mg/ml in 0.1mg/ml steps
	Concentration can also be set to OFF, in which case no mass data is displayed.	
PCA dose range	**Mass Mode:**	**0.0µg - 999µg in 1µg steps**
		1.0mg - 99.9ml in 0.1mg steps
	Volume Mode:	**0.0ml - 99.9ml in 0.1ml steps**
PCA delivery rate	**100ml/h max. STAT rate for 30ml, 50ml and 100ml syringes. 80ml/h for 20ml syringes**	
	Note: Option to set duration from 1 to 60 mins in 1min steps to minimum rate of 0.1ml/h and maximum of the STAT rate)	
Rate conversion factor	**When the pump is programmed in Mass units the conversion factor is:- ml/h = (dose/concentration)/(time in minutes/60)**	
Lockout interval	**0 - 180 minutes in 1 minute steps**	
Loading dose range	**Mass Mode:**	**0µg - 999µg in 1µg steps**
		0.0mg - 99.9mg in 0.1mg steps (Delivered at STAT rate)
	Volume Mode:	**0.0ml - 99.9ml in 0.1ml steps**
Continuous rate range	**Mass Mode:**	**0µg/h - 90µg/h in 10µg/h steps**
		0.0mg/h - 99.9mg/h in 0.1mg/h steps
	Volume Mode:	**0.0ml/h -20.0ml/h in 0.1ml/h steps.**
Maximum dose limit	**Mass Mode:**	**off, 1µg - 999µg in 1µg steps**
		1mg - 99.9ml in 0.1mg steps
	Volume Mode:	**off, 0.1ml to 999ml in 0.1mg steps**
	1 - 8 hours duration in 1 hour steps	
Purge rate	**100ml/h**	
Critical volume	**The maximum over infusion which can occur in the event of a single fault condition is 0.8ml for 20ml, 30ml and 50ml syringes and 1.5ml for a 100ml syringe.**	
Maximum Pumping Pressure Limit	**1100mmHg - nominal at L-10**	
Clinician over-ride	**In RUN mode**	**Bolus or continuous infusion. 1µg - 99.9mg or 0.1ml to 99.9ml (volume mode) bolus dose administered at the STAT rate (100ml/h) or over 1 to 180 minutes delivery period.**
	In SET mode	**Modify PCA Protocol. (when option to disable MODIFY PROTOCOL has been selected)**
System Accuracy	**Drive Linearity:**	**+/- 1%**
	Volumetric:	**+/- 2% (nominal)**
		Note: Volumetric accuracy is +/-2% typical by volume at the STAT PCA rate and above when the instrument is used with the recommended syringes. Differences in factors such as size and plunger force in compatible syringes can cause variations in accuracy and trumpet curves.
	Important: System accuracy is +/-2% typical by volume as measured using the trumpet curve test method defined in IEC EN 60601-2-24 at rates of 1.0ml/h and above when the instrument is used with the recommended syringes. Differences in factors such as size and plunger force in compatible syringes can cause variations in accuracy and trumpet curves. Also refer to trumpet curves section in relevant *DFU*.	

Electrical

Battery type	**Sealed lead acid, rechargeable**
Battery life	**6h from a fully charged battery, @ 5.0ml/h (20 ºC)**
Battery charging	**10 hours from discharge to 80% charge and 24 hours to 100% charge**
Battery replacement	**Every 3 years, or if pump fails battery test. Every 2 years where it is not possible to run a battery test.**
AC power supply	**220-240VAC, 50/60Hz, 16VA (nominal). 110-120VAC, 50/60Hz, 16VA (nominal)**
Event Log	**2000 events, rolling memory**
Memory retention	**All calibration and set up information will be retained in the pump memory for a minimum of 3 years**
Protection against electrical shock hazards	**Class II, Type CF. Complies with EN 60601-1-2 and EN 60601-2-24**

Physical

Weight	**3.5kg (excluding pole clamp and power cable)**		
Case material	**PU moulding with handle**		
Dimensions	**W**	**H**	**D**
	400mm	**115mm**	**180mm**

Environmental

Operating limits	**Temperature**	**Relative humidity**	**Atmospheric pressure**
	+10°C - +40°C	**30% - 75% non-condensing**	**700 - 1060hPa**
IPX rating	**IPX4**		
Transport/Storage limits	**-20°C - +50°C**	**5% - 95% non-condensing**	**600 - 1060hPa**

Latex Content

The IVAC® PCAM® Syringe Pump does not contain any latex.

Electromagnetic Compatibility

Warning:

- The use of any accessory, transducer, or cable with the IVAC® PCAM® Syringe Pump other than those specified may result in increased emissions or decreased immunity of the pump.
- The IVAC® PCAM® Syringe Pump should not be used adjacent to or stacked with other equipment, however if adjacent or stacked use is necessary, the IVAC® PCAM® Syringe Pump should be observed to verify normal operation in the configuration in which it will be used.

Caution:

- The IVAC® PCAM® Syringe Pump is a CISPR 11 Group 1 Class A Medical Equipment System and intended for use by healthcare professionals only.
- Medical Electrical Equipment needs special precautions regarding EMC and needs to be installed, put into service and used according to the EMC information provided in the accompanying documents.
- Portable and Mobile RF communications can affect Medical Electrical Equipment.
- Operating the pump near equipment which radiates high energy radio frequencies (electro surgical or cauterizing equipment, portable radios, cellular telephones, etc.) may cause false alarm conditions. If this happens, reposition the pump away from the source of interference or turn off the pump and manually regulate the flow.

Guidance and Manufacturer's Declaration – Electromagnetic Emissions		
The IVAC® PCAM® Syringe Pump is intended for use in the electromagnetic environment specified below. The customer or the user of the IVAC® PCAM® Syringe Pump should assure that it is used in such an environment.		
Emissions Test	**Compliance**	**Electromagnetic Environment – Guidance**
CISPR 11 RF Emissions	**Group 1**	**The pump uses RF energy only for its internal function in the normal product offering. Therefore, its RF emissions are very low and are not likely to cause any interface in nearby electronic equipment.**
CISPR 11 RF Emissions	**Class A**	**The pump is suitable for use in all establishments, other than domestic, and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.**
EN 61000-3-2 Harmonic Emissions	**Class A**	
EN 61000-3-3 Voltage Fluctuations, Flicker Emissions	**Complies**	

Electromagnetic Compatibility *(continued)*

Guidance and Manufacturer's Declaration - Electromagnetic Immunity			
The IVAC® PCAM® Syringe Pump is intended for use in the electromagnetic environment specified below. The customer or the user of IVAC® PCAM® Syringe Pump should assure that it is used in such an environment.			
Immunity Test	**EN 60601-1-2 Test Level**	**Compliance Level**	**Electromagnetic Environment – Guidance**
EN 61000-4-2 Electro-Static Discharge (ESD)	**±6 kV contact ±8 kV air**	**±8 kV contact (Note 2) ±15 kV air (Note 2)**	**Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.**
EN 61000-4-4 Electrical Fast Transient, Burst (EFT) (Note 3)	**±2 kV for power supply lines ±1 kV for input/ output lines**	**±2 kV for power supply lines N/A (Note 4)**	**Mains power quality should be that of a typical commercial or hospital environment.**
EN 61000-4-5 Power Line Surge (Note 3)	**±1 kV Line(s) to Line(s) ±2 kV Line(s) to Earth**	**±1 kV Line(s) to Line(s) ±2 kV Line(s) to Earth**	**Mains power quality should be that of a typical commercial or hospital environment.**
EN 61000-4-8 Power Frequency Magnetic Field (50/60 Hz)	**3 A/m**	**400 A/m 50 Hz (Note 2)**	**Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.**
EN 61000-4-11 Voltage Dips, Short Interruptions, and Voltage Variations (Note 3)	**<5 % U_T (Note 1) (>95 % dip in U_T) for 0.5 cycle**	**<5 % U_T (>95 % dip in U_T) for 0.5 cycle**	**Mains power quality should be that of a typical commercial or hospital environment. If the user of the pump requires continued operation during power mains interruptions, it is recommended that the pump be powered from an uninterruptible power supply or a battery. The pump does employ an internal short duration battery.**
	40 % U_T (60 % dip in U_T) for 5 cycles	**40 % U_T (60 % dip in U_T) for 5 cycles**	
	70 % U_T (30 % dip in U_T) for 25 cycles	**70 % U_T (30 % dip in U_T) for 25 cycles**	
	<5 % U_T (>95 % dip in U_T) for 5 sec	**<5 % U_T (>95 % dip in U_T) for 5 sec**	

Note 1—U_T is the AC mains voltage prior to application of the test level.
Note 2—Compliance levels raised by EN 60601-2-24.
Note 3—Performed at the Minimum and Maximum Rated Input Voltage.
Note 4—Cardinal Health recommends using signal cables of less than 3 meters in length and this requirement is applicable only if signal cables are 3 meters or more in length. (EN 60601-1-2:2002, Clause 36.202.4)

Electromagnetic Compatibility *(continued)*

Guidance and Manufacturer's Declaration—Electromagnetic Immunity
LIFE SUPPORT Equipment

The IVAC® PCAM® Syringe Pump is intended for use in the electromagnetic environment specified below. The customer or the user of the IVAC® PCAM® Syringe Pump should ensure that it is used in such an environment.

Immunity Test	EN 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment – Guidance
EN 61000-4-6 Conducted RF	3 V rms 150 kHz to 80 MHz	10 V rms (Note 3)	Portable and mobile RF communications equipment should be used no closer to any part of the pump, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended Separation Distance** $d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$
EN 61000-4-3 Radiated RF	3 V/m 80 MHz to 2.5 GHz	10 V/m (Note 3)	$d = \left[\frac{12}{V_2}\right]\sqrt{P}$ 80 MHz to 800 MHz $d = \left[\frac{12}{E_1}\right]\sqrt{P}$ 80 MHz to 2.5 GHz $d = \left[\frac{23}{E_1}\right]\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).[a] Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [b] should be less than the compliance level in each frequency range. [c] Interference may occur in the vicinity of equipment marked with the following symbol: 

Note 1—At 80 MHz and 800 MHz, the higher frequency range applies.
Note 2—These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.
Note 3—Compliance levels raised by EN 60601-2-24.

[a] The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.
[b] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the pump is used exceeds the applicable RF compliance level above, the pump should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the pump.
[c] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

Electromagnetic Compatibility *(continued)*

Recommended Separation Distances for LIFE SUPPORT Equipment between portable and mobile RF communications equipment and the IVAC® PCAM® Syringe Pump

The IVAC® PCAM® Syringe Pump is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled.
The user of the IVAC® PCAM® Syringe Pump can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the IVAC® PCAM® Syringe Pump as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Output Power of Transmitter W	Separation Distance According to Frequency of Transmitter m			
	150 kHz to 80 MHz Outside ISM bands $d = \left[\frac{3.5}{V1}\right]\sqrt{P}$	**150 kHz to 80 MHz In ISM bands** $d = \left[\frac{12}{V2}\right]\sqrt{P}$	**80 MHz to 800 MHz** $d = \left[\frac{12}{E1}\right]\sqrt{P}$	**800 MHz to 2.5 GHz** $d = \left[\frac{23}{E1}\right]\sqrt{P}$
0.01	0.03	0.12	0.12	0.23
0.1	0.11	0.38	0.38	0.73
1	0.35	1.20	1.20	2.30
10	1.11	3.80	3.80	7.28
100	3.50	12.00	12.00	23.00

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1—At 80 MHz and 800 MHz, the separation distance for the higher frequency range apply.
Note 2—The ISM (Industrial, Scientific, and Medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.
Note 3—An additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.
Note 4—These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Appendix B

Spare Parts Listing

In this chapter

Upper Case Components

Part Number	Description
0000EL00208	BATTERY NiCd 2.4V 40mAH
0000ME00002	CIRCLIP E TYPE SHAFT DIA 4.8
0000ME00009	SCREW M3x5 CSK SET CUP
0000ME00015	WASHER M3 WAVEY SST
0000ME00022	SCREW M3x6 CSK HD POSI 1 Z+BLACK
0000ME00027	WASHER M5 PLAIN Z+C
0000ME00044	FLAT WASHER NYLON M3 TO ISO 7089
0000ME00048	WASHER M3 PLAIN Z+C
0000ME00102	DISC DOUBLE SIDED TAPE
0000ME00110	SPRING COMP OD 7.62 44 LONG
0000ME00112	CIRCLIP
0000ME00116	PIN TENSION DIA 3.0x16mm
0000ME00156	COVER MAGNET LATCH
0000ME00157	SCREW M4x12 CSK SNAKE EYE
0000ME00160	O RING 3.0 I/D x 1.5
0000ME00161	O RING 4.47 I/D x 1.78
0000ME00164	SCREW M2x3 CSK HD SLOTTED
0000ME00169	SPRING EXTENSION
0000ME00170	SPRING EXTENSION
0000ME00183	SPRING COMPRESSION
0000ME00186	WASHER 13.5 X 9.61 X 0.5 NYLON
0000ME00188	WASHER 18.35 X 15.91 X 0.75 NYLON
0000ME00189	SCREW M3x12 POZI HD Z+C
0000ME00221	SCREW M3x6 PAN HD POSI ZP+P
0000ME00256	O RING 15.10 X 1.60
0000ME00257	PIN TENSION 3.0x10.0
0000ME00278	PIN DOWEL M2X10 H&G
0000ME00320	CIRCLIP E TYPE 2.3mm ID SS DIN 6799
1000EL00135	ASSY CABLE 16 WAY RIBBON
1000ME00175	ACTUATOR POTENTIOMETER MOULDED
1000ME00207	PLATE POTENTIOMETER PUNCHED
1000ME01006	CLAMP SYRINGE MACH. V4
1000ME01087	CORD SEALING SILICONE ID 0.95
1000SP00266	SPARES KIT PCAM KEYSWITCH LOCK
1000SP01017	ASSY POTENTIOMETER 50K
1000SP01053	SPARE TRANSMISSION P1/2/3 V4
5000ME00008	WINDOW DISPLAY
5000ME00012	PLATE LOCK CAM
5000ME00031	LATCH CAM
5000ME00032	ROD
5000ME00052	ARM SPRING
5000ME00053	PLATE SPRING
5000ME00055	SPEC MECHANICAL LOCK
5000ME00066	LABEL COVER SPRING ARM BUFFER
5000ME00072	SPACER BUTTON F/P CLIPON

Upper Case Components *(continued)*

Part Number	Description
5000ME00074	ROD SUPPORT
5000ME00078	SHAFT SYRINGE CLAMP P5000
5000ME00081	WASHER KEYSWITCH SEALING
5000ME00088	LOCK SEAL BODY P5000
5000ME00089	LOCK SEAL SPINDLE P5000
5000ME00090	LOCK SEALING NUT P5000
5000ME00094	MOULDING MAGNET/CATCH
5000ME00095	MOULDING BODY SPRING MECHANISM
5000ME00096	SLEEVE COVER HINGE
5000ME00099	COVER MOULDED PCAM
5000ME00108	RUBBER BUTTON CLIP ON
5000SP00001	ASSY KEYSWITCH
5000SP00017	SPARE CASE UPPER P5000
5000SP00019	SPARE UPGRADE CONTROL BOARD
5000SP00029	SPARE UPGRADE P5000
5000SP00034	SPARE UPGRADE KEYS WASHER "KW"
5000SP00035	SPARE UPGRADE KEY SWITCH ASSY
5000SP00040	SPARE UPGRADE COVER PCAM
5000SP00041	SPARE CONTROL BOARD P5
5000SP00042	SPARE DISPLAY BOARD P5
5000SP00046	ASSY SYRINGE CLAMP BONDED P5

Lower Case Components

Part Number	Description
0000EL00004	BATTERY 6V SLA RECHARGE
0000EL00284	LINK FUSE 2A PICOFUSE
0000EL00287	FUSE 63mA 20mm A/S ANTI-SURGE
0000ME00011	SCREW No4 X 1/4" PAN HD
0000ME00015	WASHER M3 WAVEY SST
0000ME00026	FOOT SELF ADHESIVE V4
0000ME00045	WASHER M4 WAVEY SST
0000ME00189	SCREW M3x12 POZI HD Z+C
0000ME00221	SCREW M3x6 PAN HD POSI ZP+P
0000ME00222	SCREW M3x6 CSK HD POSI 1 Z+BLACK
0000ME00227	SCREW
0000ME00268	SCREW M3x8 CSK HD POSI SS
0000ME00286	WASHER M4 SHAKEPROOF
0000ME00302	SCREW M4 X 50 PAN POSI
0000ME00310	WASHER M4 PLAIN ZINC PLATED
0000ME00423	PAD SELF ADHESIVE DOUBLE SIDED 12X12mm
1000LB00016	LABEL BASE PANEL 30x30
1000ME01064	FOAM PAD BATTERY
1000ME01074	GASKET MAINS INLET V4
1000ME01087	CORD SEALING SILICONE ID 0.95
1000ME01106	GASKET RS232 MOULDED & CAP A4
1000ME01123	PLATE BATTERY RESTRAINT PUNCHED
1000SP00009	ASSY CABLE BATTERY
1000SP00560	PCAM SOUNDER MODIFICATION
1000SP01001	ASSY INLET MAINS CONNECTOR
1000SP01015	SPARE POLE CLAMP 40MM
1000SP01025	ASSY NURSECALL CONN V4
1000SP01048	SPARE FLUID SEALING UPGRADE KIT
1000SP01066	SPARE UPGRADE MOULDED FOOT
5000EL00049	ASSY CABLE 16 WAY RIBBON
5000EL00072	ASSY PCB RS232/NC P5000
5000SP00018	SPARE CASE LOWER P5000
5000SP00026	ASSY HANDSET P5000
5000SP00027	ASSY HANDSET MK2 INLET
5000SP00029	SPARE UPGRADE P5000
5000SP00030	SPARE UPGRADE HANDSET P5000 'HW'
5000SP00043	SPARE POWER BOARD 230V P5
5000SP00051	SPARE UPGRADE HANDSET CONNECTOR PCAM
5001FAOPT01	OPTION RS232 N/C P5000
6000ME00026	PLATE BASE P SERIES

Transmission Assembly Components

Part Number	Description
0000EL00095	CLIP CABLE SELF ADHESIVE
0000EL00100	CABLE BLACK 7/0.2
0000ME00003	SPRING COMP OD 6.1 19 LONG
0000ME00009	SCREW M3x5 CSK SET CUP
0000ME00011	SCREW No4 X 1/4" PAN HD
0000ME00015	WASHER M3 WAVEY SST
0000ME00016	PIN TENSION DIA 2.0X10mm
0000ME00018	PIN TENSION DIA 2.0X20mm
0000ME00031	SCREW No3x3/8" PAN HD
0000ME00032	SCREW No4x1/2" PAN HD
0000ME00044	FLAT WASHER NYLON M3 TO ISO 7089
0000ME00045	WASHER M4 WAVEY SST
0000ME00048	WASHER M3 PLAIN Z+C
0000ME00084	SCREW M2x12 CSK HD SLOTTED
0000ME00101	CABLE RED 7/0.2
0000ME00132	SPIROL PIN 1.5X10 MDP
0000ME00133	SPRING COMPRESSION 2.24 DIAX7.9mm
0000ME00136	O RING 13.0 I/D x 1.5
0000ME00221	SCREW M3X6 PAN HD POSI ZP+P
0000ME00225	SCREW M4x40 PAN HD POSI 2 ZP+P
0000ME00246	SCREW M4x8 PAN HD POSI
0000ME00255	SCREW M4x20 CSK HD POSI SS
0000ME00268	SCREW M3X8 CSK HD POSI SS
0000ME00277	O RING NITRILE 11.5X1.5
0000ME00292	HEX NUT M3 STAINLESS STEEL,A4
0000ME00313	SCREW No4x1/4" CSK TRUNCATED POZI SS
0000ME00386	SPRING MUSIC WIRE
0000ME00391	WASHER 12X1.6X6.4 I/D NYLON
0000ME01066	FOAM PAD CHASSIS PLATE
1000ME00010	SPIGOT IDLER
1000ME00048	PLATE TORSION MOTOR END
1000ME00097	HALF NUT V4
1000ME00108	ACTUATOR NEOI
1000ME00174	ENCODER MOTOR
1000ME00177	SPACER DUAL TRANSMISSION
1000ME01011	LEADSCREW V4
1000ME01012	PLATE MOTOR MOUNTING P1000/2000/3000/500
1000ME01013	CARRIAGE V4
1000ME01021	PLATE CHASSIS V4
1000ME01022	PLATE OUTER TUBE SEAL V4
1000ME01027	PIN PLUNGER PLATE
1000ME01035	GRID LINEAR 1.5 PITCH V4
1000ME01047	SEAL RING OUTER TUBE
1000ME01048	SEAL RING LEADSCREW
1000ME01059	HOLDER PLUNGER V4

Transmission Assembly Components *(continued)*

Part Number	Description
1000ME01399	MOUNT OPTO MOULDED
1000ME01109	GEAR TRANSMISSION 35T P1
1000ME01113	BUSH M0TOR BEARING MOULDED
1000ME01114	BUTTON PLUNGER HOLDER MOULDED
1000ME01121	SEAL OUTER TUBE RECESSED
1000ME01122	TUBE OUTER 'O' RING GROOVE
1000ME01133	SCREW M3X8 TORX T6 SET FULL DOG
1000ME01134	SCREW M3X8 TORX T6 SET PART DOG
1000ME01305	PLATE PLUNGER RESTRAINT
1000ME01325	BACKPLATEPLUNGER HOLDER OVERMOL
1000ME01353	HOLDER PLUNGER CRUCIFORM MKII
1000SP00030	SPARE MTR G/BOX V2/V4 P SERIES
1000SP00247	PSERIES BEAM ASSEMBLY
1000SP01007	ASSY CIR FLEXI NO.2
1000SP01022	ASSY MICROSWITCH V4
1000SP01042	MOTOR G/BOX V4 ASSY P1000-3000/P5000
1000SP01053	SPARE TRANSMISSION P1/2/3 V4
1000SP01063	ASSY LEADSCREW SEAL
1000SP01084	LEVER TUBE DECLUTCH
1000SP01091	ASSY CIRCUIT FLEXIBLE No1 P1000-P3000/P5
5000SP00020	SPARE TRANSMISSION P5000
7000ME00015	ROD TORSION P7000

Keypads and Labels

Part Number	Description
1000LB01015	LABEL SET END V4/P7
1000LB00016	LABEL BASE PANEL 30x30
1000LB00059	INSTRUMENT LABEL 1" X 1 1/2
1000SP01045	SPARE KIT ALARM COVER LABEL
5000LB00020	LABEL SET P5000
5000LB00021	LABEL P5 HANDSET
5000LB00023	LABEL FP UNIV P5000

Software

Part Number	Description
1000EL00602	EPROM PROGRAM P5000
5000SP00049	SPARE UPGRADE S/W P5 GB/DE/FR
5000SP00053	SPARE UPGRADE S/WARE KIT NL
5000SP00055	SPARE UPGRADE S/WARE KIT IT
5000SP00056	SPARE UPGRADE S/WARE KIT SE

Test Equipment, Accessories and Options

Part Number	Description
0000JG00014	ASENA SP & P SERIES,TEST,PLUNGER PROTECT
0000ME00672	ADHESIVE LOCTITE 243
0000ME00052	ADHESIVE LOCTITE 495
0000ME00058	GREASE SILICONE
0000ME00107	ADHESIVE LOCTITE 603
0000TG00002	TEST GEAR P1000 LINEAR SPEED
0000TG00200	DIGITAL OCCLUSION TEST GEAR (CAL)
0000TG00032	TEST GEAR MAGNET PCAM
0000TG00055	TEST GEAR SYRINGE SIZING P5000
1000EL00043	ASSY CABLE TEST LEAD
1000SP00373	ALARIS CALIBRATION KIT
1000SP01008	ASSY CABLE RS232 (V4/PCAM)
5000JG00001	JIG CRADLE UPPER CASE P5
5000SP00008	ASSY CABLE HEAD PRINTER
5000SP00010	SPARE KEY ELEC/MECH P5000
5000SP00026	ASSY HANDSET P5000
1000SP00211	SPARES KIT BRAUN OPTION
1000SP00212	SPARES KIT JANPOL OPTION

Appendix C

Configured Options & Drug Protocol Records

In this appendix

Configured Options Record Sheet
IVAC® PCAM® Syringe Pump

Enter the pump-specific information for your records

Hospital / Institution: _____ ***Department/Ward:*** _____

Option	Range		Default	Setting
ICONS ON DISPLAY	YES/NO		NO	
PROTOCOLS IN USE	1 - 10		5	
MODIFY PROTOCOL	YES/NO		YES	
HANDSET MODE	A / B / C		A	
DELAYED CALLBACK	YES/NO		YES	
DISPLAY SLEEP	YES/NO		YES	
CHIRP LOW ALARMS	YES/NO		NO	
CONTINUOUS INFUSIONS	YES/NO		YES	
LOADING DOSES	YES/NO		YES	
MAX DOSE LIMITS	YES/NO		YES	
VARIABLE DOSE RATES	YES/NO		YES	
COMMS PUMP IDENTITY	000 - 127		001	
COMMS ENABLED	YES/NO		YES	
NURSE CALL	YES/NO		NO	
NURSE CALL INVERTED	YES/NO		NO	
CONTINUOUS PRINT	YES/NO		NO	
DEFAULT SYRINGE	BD PLASTIPAK IVAC TERUMO B. BRAUN OMNIFIX MONOJECT R.R PRONTO BD WORLDWIDE ONCE	FRESENIOUS INJECT. RAPIJECT PHARMA-JECT BD PRECISE BRAUN PERFUSOR* JANPOL* * with options kit fitted	BD PLASTIPAK	
LOCK SYRINGE TYPE	YES/NO		NO	
QUIET MODE	YES/NO		NO	
GENERIC DRUG ENABLED	YES/NO		YES	
MAX DOSE LIMIT ALARM	YES/NO		YES	
MIX MASS & VOL MODES	YES/NO		NO	

Syringe Type	Enabled
UNIVERSAL	
BRAUN PERFUSOR	
JANPOL	

Model: _____ ***Serial Number:*** _____ ***Software Version:*** _____

Configured by: _____ ***Date:*** _____

Approved by: _____ ***Date:*** _____

Drugs and Protocols - IVAC® PCAM® Syringe Pump

Enter the pump-specific information for your records

Hospital/Institution: _____

Drug names and Safety Limits

Department/Ward: _____

Drug number	Mass Range	Volume Range	1	2	3	4	5	6	7	8	9	10
Drug Name (12 characters)												
Dose Mode	Mass	Volume										
Minimum Drug Concentration	1µg/ml - 99.9mg/m	Off, 1µg/ml - 99.9mg/ml										
Maximum Drug Concentration	1µg/ml - 99.9mg/ml	1µg/ml - 99.9mg/ml										
Minimum Lockout Period	0 - 180 minutes	0 - 180 minutes										
Maximum Lockout Period	0 - 180 minutes	0 - 180 minutes										
Minimum PCA Dose	0µg - 99.9mg	0.0ml - 99.9ml										
Maximum PCA Dose	0µg - 99.9mg	0.0ml - 99.9ml										
Maximum Continuous	0µg/h - 999.0mg/h	0.0ml/h - 35ml/h										
Maximum Loading Dose	0µg - 99.9mg	0.0ml - 99ml										
Maximum Max Limit	0µg - 999mg	0.0ml - 999ml										
Maximum Clinician Bolus	1µg - 99.9mg	0.1ml - 99.9ml										

Protocol Default Set Up

Protocol number	A	B	C	D	E	F	G	H	I	J
Drug Name										
Drug Concentration										
PCA Dose										
Lockout Period										
Occlusion Level										
Continuous										
Loading Dose										
Max Limit										
Limit Duration										
PCA Delivery										

Model: _____

Serial Number: _____ ***Configured by:*** _____ ***Date:*** _____

Software Version: _____ ***Approved by:*** _____ ***Date:*** _____

Appendix D

Service Contacts

Service Contacts

For service, contact your local Cardinal Health Affiliate Office or Distributor.

AE

Cardinal Health,
PO Box 5527,
Dubai, United Arab Emirates.
Tel: (971) 4 28 22 842
Fax: (971) 4 28 22 914

AU

Cardinal Health,
8/167 Prospect Highway,
Seven Hills, NSW 2147,
Australia.
Tel: (61) 2 9838 0255
Fax: (61) 2 9674 4444
Fax: (61) 2 9624 9030

BE

Cardinal Health,
Otto De Mentockplein 19,
1853 Strombeek - Bever,
Belgium.
Tel: (32) 2 267 38 99
Fax: (32) 2 267 99 21

CA

Cardinal Health,
235 Shields Court,
Markham,
Ontario L3R 8V2,
Canada.
Tel: (1) 905-752-3333
Fax: (1) 905-752-3343

CN

Cardinal Health,
Shanghai Representative Office, Suite 9B,
Century Ba-Shi Building,
398 Huai Hai Rd(M.),
Shanghai 200020,
China.
Tel: (56) 8621-63844603
Tel: (56) 8621-63844493
Fax: (56) 8621-6384-4025

DE

Cardinal Health,
Pascalstr. 2,
52499 Baesweiler,
Deutschland.
Tel: (49) 2401 604 0
Fax: (49) 2401 604 121

ES

Cardinal Health,
Avenida Valdeparra 27,
28108 - Alcobendas,
Madrid, España.
Tel: (34) 91 657 20 31
Fax: (34) 91 657 20 42

FR

Cardinal Health,
Immeuble Antares - Technoparc,
2, rue Charles-Edouard Jeanneret.
78300 POISSY,
France.
Tél: (33) 1 30 06 74 60
Fax: (33) 1 39 11 48 34

GB

Cardinal Health,
The Crescent, Jays Close,
Basingstoke,
Hampshire, RG22 4BS,
United Kingdom.
Tel: (44) 0800 917 8776
Fax: (44) 1256 330860

HU

Cardinal Health,
Döbrentei tér 1,
H-1013 Budapest,
Magyarország.
Tel: (36) 14 88 0232
Tel: (36) 14 88 0233
Fax: (36) 12 01 5987

IT

Cardinal Health,
Via Ticino 4,
50019 Sesto Fiorentino,
Firenze, Italia.
Tél: (39) 055 30 33 93 00
Fax: (39) 055 34 00 24

NL

Cardinal Health,
Kantorenpand "Hoefse Wing",
Printerweg, 11,
3821 AP Amersfoort,
Nederland.
Tel: (31) 33 455 51 00
Fax: (31) 33 455 51 01

NO

Cardinal Health
Solbråveien 10 A,
1383 ASKER,
Norge.
Tel: (47) 66 98 76 00
Fax: (47) 66 98 76 01

NZ

Cardinal Health,
14 George Bourke Drive
Mt Wellington, Auckland
PO Box 14234
Panmure, Auckland
Tel: 09 270 2420
Freephone: 0508 422734
Fax: 09 270 6285

SE

Cardinal Health,
Hammarbacken 4B,
191 46 Sollentuna,
Sverige.
Tel: (46) 8 544 43 200
Fax: (46) 8 544 43 225

US

Cardinal Health
10221 Wateridge Circle,
San Diego, CA 92121,
USA.
Tel: (1) 800 854 7128
Fax: (1) 858 458 6179

ZA

Cardinal Health,
Unit 2 Oude Molen Business Park,
Oude Molen Road, Ndabeni,
Cape Town 7405, South Africa.
Tel: (27) (0) 860 597 572
Tel: (27) 21 510 7562
Fax: (27) 21 5107567

Appendix E

Disposal

In this chapter

Ensure the Pump is disconnected from the AC power supply and switched off before attempting to service.

The Pump contains static-sensitive components and therefore strict ESD precautions should be observed at all times.
Only use Cardinal Health recommended spare parts.
Following all spare part replacement and repair activities, testing must be performed in accordance with the Performance Verification Procedure (PVP), see Chapter 3, Routine Maintenance.

Disposal

Information on Disposal for Users of Waste Electrical & Electronic Equipment

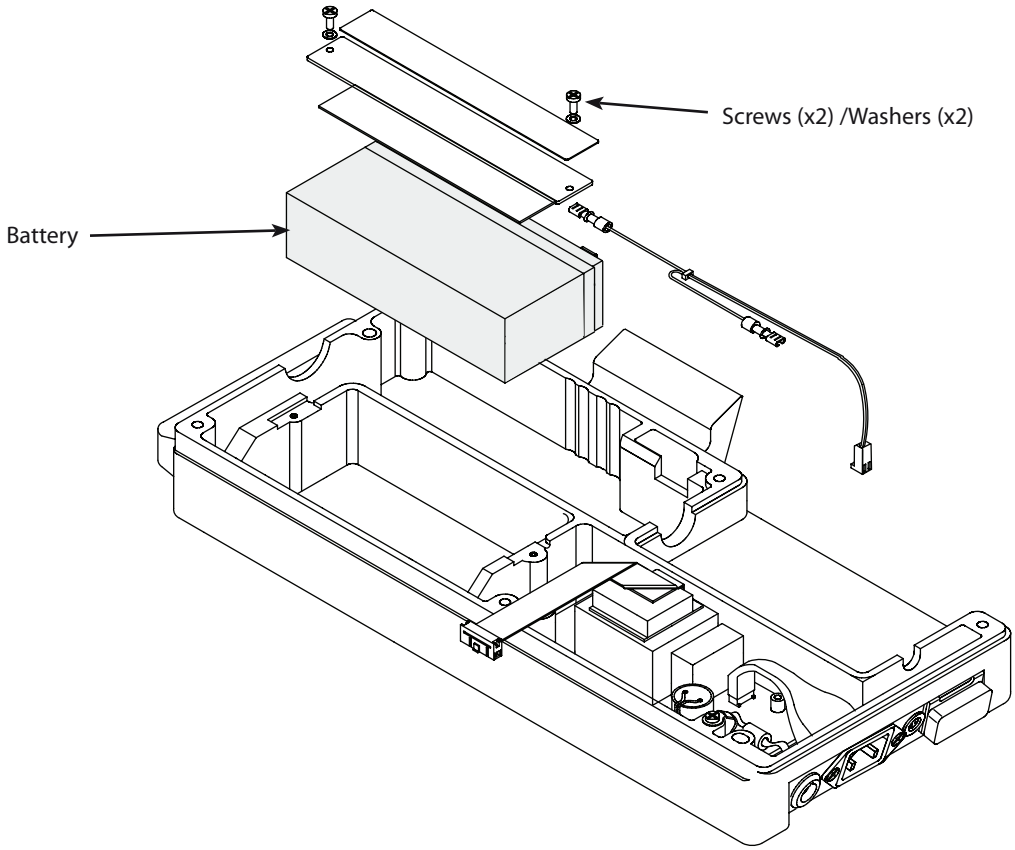
This symbol on the product and/or accompanying documents means that used electrical and electronic products should not be mixed with municipal waste.
If you wish to discard electrical and electronic equipment, please contact your Cardinal Health affiliate office or distributor for further information.
Disposing of this product correctly will help to save valuable resources and prevent any potential negative effects on human health and the environment which could otherwise arise from inappropriate waste handling.

Information on Disposal in Countries outside the European Union
This symbol is only valid in the European Union. The product should be disposed of taking environmental factors into consideration.
To ensure no risk or hazard, remove the internal rechargeable battery and the Lithium battery from the control board and dispose of as outlined by the local country regulations. All other components can be safely disposed of as per local regulations.

Battery Removal

Removal Procedure

1. Remove the handset assembly.
2. Remove the six case retaining screws and washers located on the base of the pump.
3. Carefully separate the upper and lower case halves and disconnect cables.
4. Disconnect the battery cable from the Power Supply PCB.
5. Remove the two screws which secure the battery retaining plate.
6. Lift out the battery and retaining plate then disconnect the crimp terminals from the battery.
7. Detach the retaining plate from the battery.

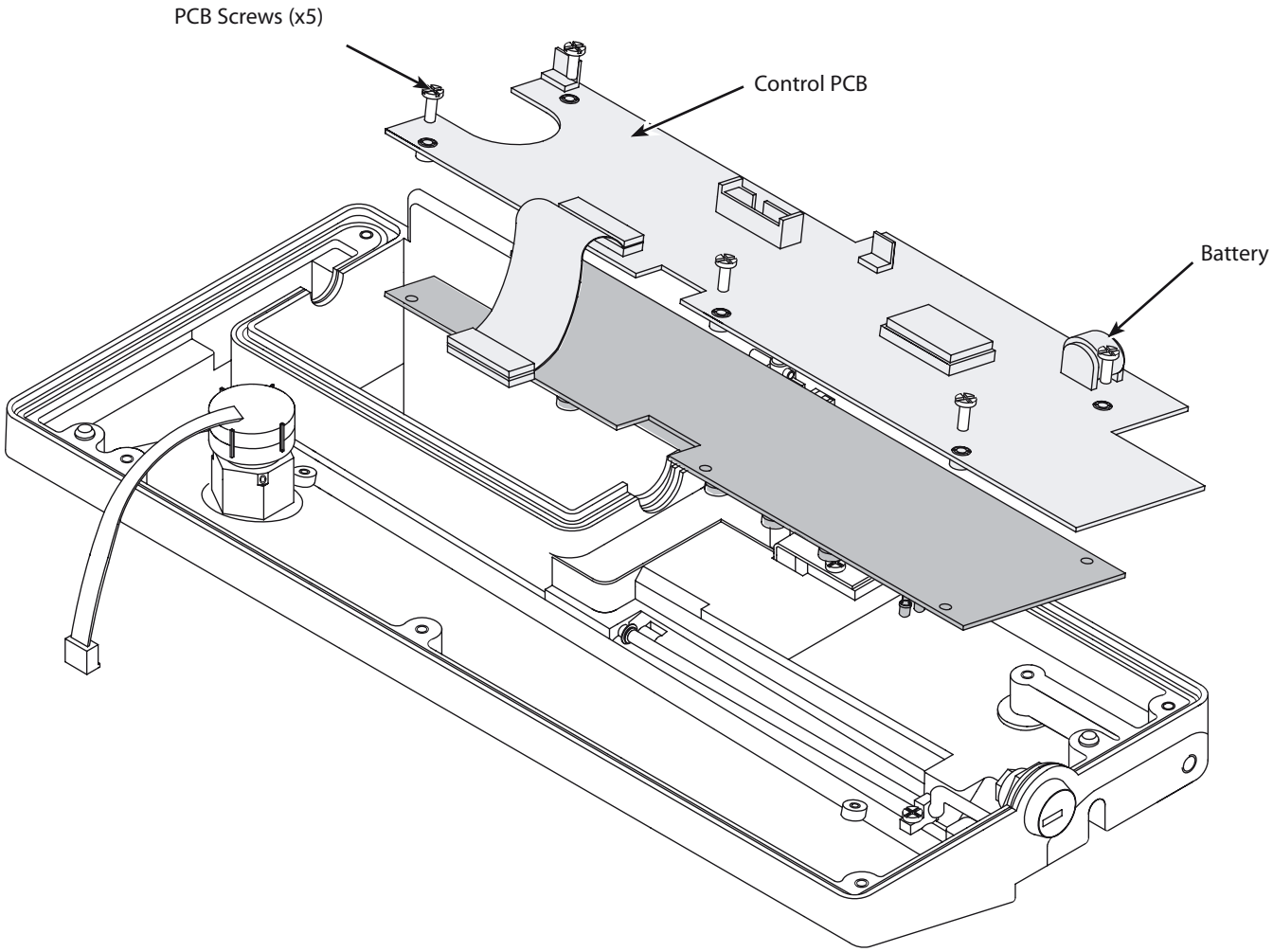


Battery Removal continued

Removal Procedure

1. Remove the handset assembly.
2. Remove the six case retaining screws and washers located on the base of the pump.
3. Carefully separate the upper and lower case halves and disconnect cables.
4. Disconnect the cables from the Control PCB.
5. Remove the five PCB fixing screws and washers and withdraw the Control PCB and Display PCB together.
6. Disconnect the backlight connector and pull the PCBs apart.
7. Desolder battery from the Control PCB.

The transmission is not shown here for clarity—it is not necessary to remove the transmission assembly in order to remove the Control PCB and the Display PCB.



Appendix F

Document History

Document History

Issue	Date	CO No.	Author	Update Description
1	Sept 2005	4709	Clare Coney	Initial release - (Supersedes 5000PB00004)
2	Nov 2006	7239	Ian Tyler	Moved Document History and Service Contacts to Appendixes Added Disposal appendix Updated information on loctite glues. Added Instructions on setting the language. Changed Manufacturers address.